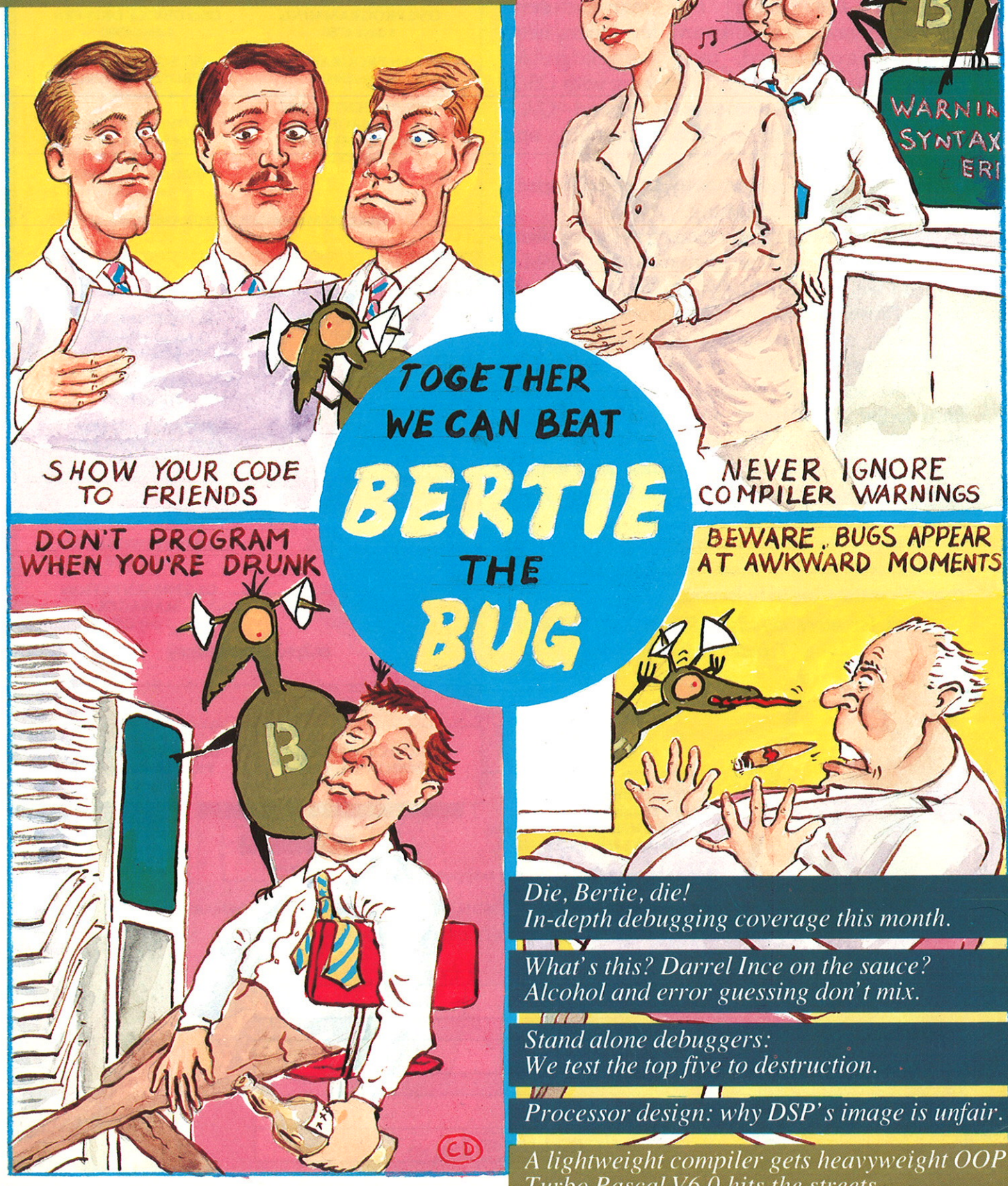
06 DEC 1990

£3.20

.EXE

The Software Developers' Magazine

DECEMBER 1990 VOL 5 ISSUE 7



Die, Bertie, die!
In-depth debugging coverage this month.

What's this? Darrel Ince on the sauce?
Alcohol and error guessing don't mix.

Stand alone debuggers:
We test the top five to destruction.

Processor design: why DSP's image is unfair.

A lightweight compiler gets heavyweight OOP.
Turbo Pascal V6.0 hits the streets.

THE TRAINING LEADERS

The best OS/2 training and consultancy...

'Number One in OS/2'

When the major PC manufacturers, corporates and software developers need the most experienced, most knowledgeable, most thorough assistance in working with OS/2, one company comes immediately to mind – QA.

QA's leadership in OS/2 training and consultancy is unique.

We were the first company to be authorised by Microsoft for OS/2 training.

We were the company chosen to be suppliers of OS/2 training and education materials to IBM.

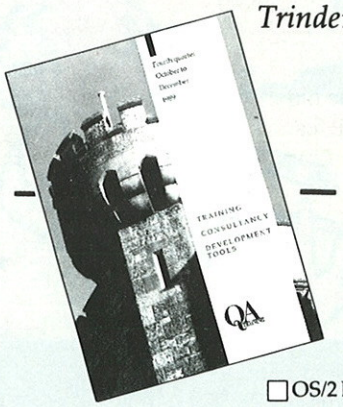
And we were the first company in the world to give Presentation Manager training.

Today, our wide range of courses provide subject-specific training, or progression through a linked series of courses, to give you the knowledge to achieve your particular OS/2 objectives.

And our consultants' expertise and experience can assist you to achieve your design goals without costly mistakes.

So if you are interested in getting the best out of OS/2, why not join those who have discovered that QA is the One to help you.

Send for more details today or call Samantha Trinder on 0285 655888.



OS/2 DEVELOPMENT COURSES

OS/2 PROGRAMMING
4 days £780

OS/2 DEVICE DRIVERS
4 days £980

OS/2 LAN PROGRAMMING
4 days £860

OS/2 SQL DATABASE PROGRAMMING
4 days £860

OS/2 PRESENTATION MANAGER PROGRAMMING
5 days £920

ADVANCED OS/2 PRESENTATION MANAGER PROGRAMMING
4 days £980

DIALOG MANAGER PROGRAMMING
3 days £620

...ALSO SUPPORT...

SUPPORTING OS/2
3 days £580

SUPPORTING OS/2 LAN MANAGER
4 days £760

OS/2 EE
9 days £1,580

OS/2 PRIMER
2 days £360

SUPPORTING OS/2 COMMUNICATIONS MANAGER
3 days £620

SUPPORTING IBM OS/2 AND DOS LANS
4 days £760

...AND SEMINARS...

OS/2 BRIEFING
1 day £200

OS/2 NETWORKING
1 day £200

OS/2 TECHNICAL OVERVIEW
1 day £200

OS/2 PRESENTATION MANAGER
1 day £200

OS/2 SQL DATABASES
1 day £200

...OR CONSULTANCY.

PROJECT ANALYSIS
DESIGN VETTING

DESIGN STANDARDS
PROBLEM SOLVING

Please complete and mail to:
QA Training,
Cecily Hill Castle, Cirencester,
Glos GL7 2EF, ENGLAND

Microsoft® Authorised

IBM Suppliers of OS/2 training and education materials to IBM

Please send me full details on (tick as appropriate):

☐ OS/2 DEVELOPMENT COURSES ☐ OS/2 SUPPORT COURSE ☐ OS/2 SEMINARS
☐ OS/2 CONSULTANCY ☐ OTHER QA COURSES & SEMINARS

NAME | TITLE

COMPANY

ADDRESS

CIRCLE NO. 375 | TEL. NO.

QA TRAINING

Vol 5 Issue 7

.EXE

December 1990

Administration & Subscriptions: Rena Gibbs, Sandy McDonnell, Marianne & Ian
Reader Services & Promotions: Helena Adams
Senior Ad Executive: Ed Butcher
Display Advertising Manager: Sandra Inniss-Palmer
Santa's Gnomes (production): Katerina Adams, Mark Taylor-English
Editorial Assistant: Wendie Leek
News Editor: Dan O'Brien
Editor: William Robert Watts
Publisher: Jon Howell
Front Cover Illustration: Chris Duggan

Happy Christmas Everybody!

General

.EXE Magazine is independent and not affiliated to any vendor of hardware, software or services. It is published by Process Communications Ltd, 10 Barley Mow Passage, Chiswick, London W4 4PH.
Tel: (Advertising/Editorial/Production) 081 994 6477
(Subscriptions) 044282 4501
Facsimile: 081 994 1533 Telex: 8811418 SPACES G
ISSN: 0268-6872

Subscriptions

.EXE Magazine is a monthly journal for software developers. It is available only by subscription, at a cost of £35 per annum (11 issues) in the UK (see insert card for academic and overseas rate). 'A subscription implies that this journal will be sent to the subscriber until one of the three expires' - AG Macdonell. The magazine is published around the 26th of the month preceding the cover date. There is no January issue. To subscribe, please call 044282 4501, or write to The Subscriptions Manager, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. We can invoice your company or take ACCESS and VISA cards. In case of a query about your subscription, please call 044282 4501.

Back issues are available at a cost of £3.50 each - call our Chiswick office (081 994 6477) for a list of issues still in print. We also offer a range of magazine binders, disk holders etc - please call for details.

Editorial

Editorial enquiries should be addressed to The Editor, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. We welcome letters, opinions, suggestions and articles from our readers. If you are interested in contributing articles, please write to this office for a copy of our Contributors' Guide.

Information contained in .EXE is believed to be correct. If errors are found, we will endeavour to publish a clarification in the next available issue.

From time to time, we offer to copy the FC program code described in an article onto diskette for our readers. In this case, please send a blank, formatted disk with a self-addressed, prepaid mailer to the editorial address given above. We can copy both 5.25" and 3.5" disks.

The publishers can accept no liability for any consequences of using software distributed in this way.

Advertising

If you are interested in advertising in this magazine, please write to the Display Advertising Manager/Recruitment Sales Manager (as appropriate), .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH, or call 081 994 6477 for details of our advertising rates.

Pronunciation

The name of .EXE Magazine is pronounced to rhyme with 'not sexy magazine'.

Copyright

Material published in .EXE Magazine is copyright © Process Communications Ltd. Articles (or parts of articles) may not be copied, distributed or republished without written permission from the publishers.

Special Issue - Debugging

WOT, NO PSYCHOTIC?
Prof Darrel Ince explains what IBM does with its more difficult employees, and suggests how to get by without somebody useless in your programming team. *14*

AT THEIR BREAKING POINT
Do you need a DOS debugger? The top source code debuggers are put through their paces by Dan O'Brien. *20*

GATHERING PROGRAM STATISTICS WITH C++
Bryan Boreham has developed a simple yet ingenious use of C++'s destructor mechanism. He presents full story + source. *27*

SIX TRIX
Turbo Pascal V6.0 includes 'Turbo Vision', which is billed as an object-oriented applications framework.
Paul Smith and Will Watts explain what this is. *32*

'I AM NOT SPOCK...'
According to Jon Moseley, DSP suffers from the Leonard Nimoy syndrome: everybody thinks it's got pointy ears. Jon thinks we should take fewer RISCs. *43*

SOAPBOX
Ron Newsham believes that the way towards less buggy programs is through mental tricks. *2*

NEWS
A major turnaround on the Windows front, the latest PC graphics standard from IBM and OS/2 V1.3 takes a bow. *4*

LETTERS
We hear from a man who loves FORTRAN, the C++ debate continues, and how the clearing banks should take Peter Collinson's advice. *10*

THE THIRD SIDE
Al Roth and John Domingue examine one of the oldest surviving computer languages, showing off some of its unique OOP features. *52*

CODE PAGE
Jeff Goldberg describes the simplest bit of any Windows program: the MS-DOS stub. *58*

UNIX REGULAR
Peter Collinson was intrigued to see that Unisys, an American giant, was getting UNIX kernel technology from a small French company, Chorus systèmes. *64*

BOOKS
We discover surprising depths to driving character displays in C and, as a Christmas novelty, a novel. *71*

CROSSWORD
An extra clue: Eric Deeson, our puzzle setter, is in a seasonal mood. *74*

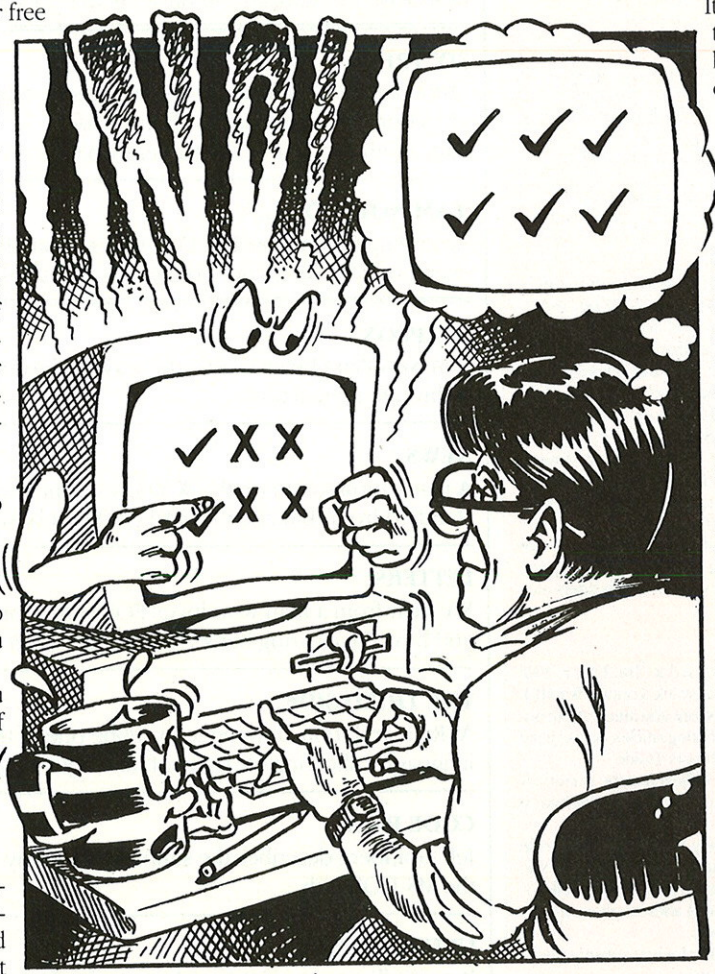
STOB
Big sister Parity Stob writes on how to survive a code walk-through. *80*

Debugging with Double-think

According to popular myth, Real Programmers do not need anything more sophisticated than a hex dump to debug their programs. Ron Newsham says that even this should be unnecessary.

Formal methods are being developed so that you can reason mathematically that a design is correct. Total Quality Management programmes are developed to reach the magical 'Zero Defects' standard. Formal inspection methods are introduced to ensure that code conforms to requirements. These are good things, but there is a more fundamental way of encouraging error free programs.

Psychologists tell us that we have a mental model of the world. This model sets a standard against which we compare reality. Incoming information from our senses is filtered by this model. We only accept information that agrees with our model, otherwise the amount of information that we receive would cause a serious overload. But if some information is accepted, other information that does not agree with our model is rejected. This happens automatically and quite unconsciously. Psychologists call this 'perception'.



You can program this mental model to accept or reject different things. This is called a 'set' by psychologists. The mental set that you have affects your self image, approach to work, hobbies and life in general. If you have a negative self image, this will be reinforced by the mistakes you make. On the other hand, a positive self image minimises mistakes and reinforces successes. This is why you are told to be positive about yourself and 'go for it'!

Why all this 'pop psychology' in a magazine for programmers? As a programmer, you will create designs and code that should be perfect and not need to be checked, but they are frequently found to contain bugs. Why should this be? As a highly trained professional, mistakes should not occur. The trouble is that the mind is set to expect work that is perfect and error free. Errors are simply not seen. Although this model is wrong it is difficult to go through life expecting everything you do to be wrong. That way lies madness (or at least clinical depression).

You, of course, are not like this - as an ego-less programmer you know that you are likely to be fallible. However, because the mind set filter works automatically, it is easy to forget the fact that it is operating. There are any number of common errors that everybody knows about, errors that are so basic that nobody with more than two minutes experience will make them. Even when you edit a program for the thirty-second time, mutter the magical incantation 'this time ...', and compile it, you can easily overlook the fundamental bug that has been there all along simply because you do not expect to make such a trivial mistake. Just as spelling check programs might correct the words that you type but not check for the correct word in context, compilers are good for finding errors in syntax but not in the program's logic. It is too easy to assume that the program is correct simply because the compiler did not complain.

Be honest, have you never written a document, passed it through your favourite spell-check program and painstakingly proof-read it. Then you issue it. The first person to glance over the issued document even casually is the one who notices the glaring error on the first page where the company's name is spelled incorrectly.

A good deal of time, effort and frustration can be saved if you program your mental model to realise that those simple errors will occur. By all means write your code thinking that it is the most perfect piece of code ever written. Then read through the code you have written actively looking for errors. Suspect everything - the bugs are there! You only need to open your eyes to see them. Nobody else need know that you think that there may be something wrong. Even when you are happy with the code, there is still room for errors. Get somebody else to check it, or read it to them. Time spent getting it right from the start will pay dividends.

Trendy window based symbolic debugging tools that know all about the target environment are fine and well, but the real breakthrough in debugging is to set your mind to **see** your errors before they are committed to object code. EXE

For the last two years, Ron Newsham has been training software engineers as to how to write programs in C and generally how to drive computers. Prior to that he was a software engineer for six years. He also teaches people to be more creative and use their minds more effectively.

ADA COMPILERS

The new AdaZ is the first to offer a full development system at a realistic price.

AdaZ	PC-DOS	£260
AdaVantage Prof Dev Kit	PC-DOS	£2495
AdaStudent	PC-DOS	£ 75
Janus/Ada MS-DOS comp'lr	MS-DOS	£330
IntegrAda	PC-DOS	£645

CROSS ASSEMBLERS

We supply cross-assemblers by Avocet, 2500AD,Crash Barrier (METAI),IAR Systems and Pecan hosted on MS-DOS, CP/M-86 and CP/M-80 with over 30 target processors. In total over 200 products with no space to list them here. We hold some stock but you should allow 10-14 days for delivery. Please call for information or advice.

PROGRAMMING TOOLS

Ada Compilers	Algol Compilers
Assemblers & Libs	AWK
Basic Compilers	Basic Interpreters
Basic Utilities	Basic Libraries
BCPL Compilers	C Compilers
C Interpreters	C Libraries
C Utilities	Cobol Compilers
Comms.Libraries	Cross Assemblers
Database Libs.	Debuggers
Dis-assemblers	Editors
Engineers Libs.	Expert Systems
Forth	Fortran Compilers
Fortran Libraries	Graphics Libraries
Icon	Linkers/Locaters
Lisp	Modula-2
Nial Interpreters	OPS 5
Pascal Compilers	Pascal Libraries
Prolog	Rexx
Risc	Screen Libraries
Smalltalk	Snobol

We stock many items for which there is no space in these advertisements.

THE C LANGUAGE

Microsoft C V6 is a complete rewrite with improved optimisation and a new Programmer's Workbench High C V1.6 has been considerably improved, with better Microsoft C compatibility, and new documentation

C COMPILERS

Avocet C	PC-DOS	£210
Aztec C86 Professional	MS-DOS	£120
Aztec C86 Developer	MS-DOS	£175
Aztec C86 Commercial	MS-DOS	£265
CI C86 Plus v1.3	MS-DOS	£290
ECO-C88 V4.0	MS-DOS	£ 70
HIGH C (Metaware) v1.6	MS-DOS	£380
HIGH C 386 v2.3	PL386&MS-DOS	£640
Hi-Tech C	MS-DOS	£135
Lattice C v6	OS/2&MS-DOS	£175
Let's C v4	MS-DOS	£ 60
Microsoft C v6	OS/2&PC-DOS	£269
Microsoft QuickC v2.5	PC-DOS	£ 60
M'soft QuickC/QuickAsm	PC-DOS	£105
MIX C	MS-DOS	£ 20
MIX Power C & lib s'ce	PC-DOS	£ 29
Turbo C++	PC-DOS	£120
Topspeed C for OS/2	OS/2	£335
Topspeed C (std)	PC-DOS	£135
Topspeed C Extended	PC-DOS	£270
Watcom C v8 std	MS-DOS	£269
Watcom C v8 Prof	OS/2&DOS	£335
Watcom C/386 std	PL386&MS-DOS	£625
Watcom C/386 Prof	PL386&MS-DOS	£830
Zortech C++ v2.1	PC-DOS	£120
Z'tech C++ v2.1 Devlper	PC-DOS	£270
Z'tech C++ OS/2 Option	OS/2	£ 90
Aztec C86 Developer	CP/M-86	£245
Aztec C86 Personal	CP/M-86	£140
Hi-Tech C	CP/M-86	£150
Lattice C	CDOS	£380
HIGH C (Metaware)	Flex OS 286	£405
Avocet C	CP/M-80	£210
Aztec C Personal 1.06D	CP/M-80	£120
Aztec Commercial 1.06D	CP/M-80	£200
Hi-Tech C	Z80 + CP/M-80	£ 99
Mix C	Z80 + CP/M-80	£ 35
Aztec C65 V1.05	Apple DOS	£200
Aztec C68K MPW C	MACINTOSH	£110
Aztec C68K C	MACINTOSH	£ 75
Aztec C68K/AM Developer	AMIGA	£175
Aztec C68K/AM Prof'snl	AMIGA	£120
Aztec C68K/ST Developer	ATARI	£175
Aztec C68K/ST Prof'snl	ATARI	£120
Hi-Tech C	ATARI	£ 99
Lattice C v3.04	ATARI	£ 85
Mark Williams C v2	ATARI	£110
Laser C	ATARI	£135
Prospero C	ATARI	£105

C CROSS COMPILERS

We supply 2500AD, Avocet, Aztec, Lattice, IAR and HI-Tech Cross Compilers hosted on MS-DOS and targeted on Z80, 6502, 6801, 68HC11, 6301, 6809, 7811, 8051, 8096, 68000 & 68020. Please call for information or advice.

C INTERPRETERS

Instant C/16M supports large programs on 286/386 machines.

C-terp V3.0X	PC-DOS	£165
Instant C/16M	PC-DOS	£725
Interactive C	PC-DOS	£195
Introducing C	PC-DOS	£ 85
Living C Plus	PC-DOS	£135
RUN/C Professional	MS-DOS	£110

PRICES & DELIVERY

Prices do not include VAT or other local taxes but do include delivery in UK and Europe. Please check prices at time of order, ads are prepared some weeks before publication. This page lists some of our products. Call us for a complete pricelist. Order by phone with your credit card.

C LIBRARIES

DATABASE/FILEHANDLING

Btrieve for OS/2	OS/2	£360
Btrieve for Windows	MS-DOS	£360
Btrieve v5.1	MS-DOS	£360
XQL	OS/2,PC-DOS	£460
Xtrieve Plus	OS/2,PC-DOS	£360
C/Database T'lchest sce	PC-DOS	£ 39
CBTREE	(source any C)	£135
C-Index/Plus	(source any C)	£175
C-ISAM (L,MS)	MS-DOS	£215
C-tree	(source any C)	£230
Essential Btree (s'ce)	PC-DOS	£120
CQL s'ce	PC-DOS	£270
Faircom Toolbox Prof	PC-DOS	£610
Pro-C & Workbench v2	PC-DOS	£585
R-tree	MS-DOS	£170
db-VISTA DBMS Object	PC-DOS	£450
Lattice dBCIII (L,MS)	MS-DOS	£185
Lattice dBCIII+	OS/2&MS-DOS	£365
SftFcus Btree&Isam (sce	any C)	£ 80
Zortech Btree/ISAM	PC-DOS	£ 75

GRAPHICS

Enhanced Graphics Tlkt	PC-DOS	£170
Essential Graphics v3	PC-DOS	£215
GFX Graphics	PC-DOS	£ 80
GraphiC v5 (CI,L,DS,MS)	PC-DOS	£290
graphics MENU/META v3	PC-DOS	£135
GSS Kernel system	OS2,PC-DOS	£425
GSS Graph Dev T'kit	OS2,PC-DOS	£425
HALO v3 (MSC5,LAT,TC)	PC-DOS	£225
HGraph (MSC)	PC-DOS	£ 80
Ingraf (MSC)	PC-DOS	£175
MetaWINDOW v3.6A	PC-DOS	£135
MetaWINDOW/Plus	PC-DOS	£175
MetaWINDOW/Premium	PC-DOS	£265
Professional Halo	PC-DOS	£335
TurboWINDOW/C (Turbo)	PC-DOS	£ 79
QuickWINDOW/C (QC)	PC-DOS	£ 79

SCREEN & WINDOWS

Vitamin C for OS/2	OS/2&DOS	£240
Power Screen (MS&TC)	PC-DOS	£105
Blaise View Mngr.(s'ce)	PC-DOS	£245
Lattice Curses	PC-DOS	£105
Entelekon Windows(s'ce)	PC-DOS	£105
Multi-windows (MS,L)	PC-DOS	£190
Panel Plus II (source)	PC-DOS	£270
Vitamin C (source)	PC-DOS	£165
Vermont Views (MSC,TC)	PC-DOS	£345
Greenleaf Datawindow	PC-DOS	£180
Greenleaf Makeform	PC-DOS	£ 60
C-Scape(+s'ce&Look&Feel)	PC-DOS	£345
Zortech Windows(ZC++ZC3)	PC-DOS	£ 39
Curses/PC w. s'ce	PC-DOS	£265

PROGRAMMERS UTILITIES

PC-Lint	OS/2,MS-DOS	£ 85
C-Documentor	PC-DOS	£195
C-Scan	PC-DOS	£195
Clear+ for C	PC-DOS	£165
Lattice Comp Companion	MS-DOS	£ 65

GENERAL FUNCTIONS

C+0 Class Lib (MS,TC)	PC-DOS	£155
C+0 Cl's Lb (MS)	WINDOWS&PC-DOS	£155
C/Utilities T'chest sce	PC-DOS	£ 39
C-Worthy v1.2 + forms	MS-DOS	£340
Code Runner	PC-DOS	£105
PDK£1	PC-DOS	£ 75
Greenleaf Functions s'ce	PC-DOS	£135
G'leaf Super Functions	PC-DOS	£175
G'leaf Fin'cial Mathlib	PC-DOS	£230
Lattice C Comp Kit+s'ce	PC-DOS	£160
The Heap Expander(MS&TC)	PC-DOS	£ 65
C Tools Plus/6.0 (MS)	PC-DOS	£105
Power Search	PC-DOS	£105
Turbo C Tools v2	PC-DOS	£105
Essential C Utils s'ce	PC-DOS	£145
Entelekon Funct(source)	PC-DOS	£105
Resident-C (MS,L)(s'ce)	PC-DOS	£145
Silverware C EMM Lib	PC-DOS	£115
WKS Library	PC-DOS	£160
Zortech Supertext	PC-DOS	£ 39

COMMS LIBRARIES

C Asynch Manager V3s'ce	PC-DOS	£130
Essential Comms(L,MS,T)	PC-DOS	£175
Greenleaf Comms(source)	PC-DOS	£195
Multi Comms (L,MS)	PC-DOS	£190
Silvercomm C Asynch	PC-DOS	£145
Zortech Comms (QC&TC)	PC-DOS	£ 65
Zortech Comms(ZC++&ZC3)	PC-DOS	£ 65

SCIENTIFIC LIBRARIES

C Lang Sci Lib v2	ANY C	£175
Mathpak 87 (L,MS)	MS-DOS	£ 80

REAL TIME & MULTI-TASKING TOOLS

Concurrent C (PC/MPX)sce	MS-DOS	£ 60
Multi C (L,MS,CI,TC)	PC-DOS	£190
Op.Sys.T'box (MS) s'ce	PC-DOS	£ 69
Timeslicer v5 (MS5)	PC-DOS	£165
Over-C (L,MS)	PC-DOS	£225

DISK COPYING SERVICE

We can copy files to and from 600 disk formats including CP/M, CP/M-86, MS- DOS, PC-DOS, ISIS, APPLE, SIRIUS, BBC, TORCH, APRICOT, HP-150, TRSDOS, DEC RT- 11, IBM BEF, ATARI ST, AMSTRAD, MACINTOSH.

Our charge is £10.00 + disk + VAT with discounts on small quantities and disks are normally despatched within 24hrs of receipt. For more information call us.

ASSEMBLERS

2500AD 80386 ASM v5	PC-DOS	£225
MS Macro-86 v5.1	OS/2&PC-DOS	£ 95
PharLap 386 DOS Ext SDK	MS-DOS	£370
PharLap 386 ASM/Linkloc	MS-DOS	£890
PharLap 386/VMM	MS-DOS	£240
Optasm	MS-DOS	£ 95
Turbo Debugger v2	PC-DOS	£105
2500AD Z80 ASM	CP/M-80	£ 70
SLR Z80ASM	CP/M-80	£ 40
SLR Z80ASM-PLUS	CP/M-80	£140
SLR MAC	CP/M-80	£ 40
SLR MAC-PLUS	CP/M-80	£140
SLR 180 (Hitachi)	CP/M-80	£ 40
SLR 180-PLUS (Hitachi)	CP/M-80	£140

FORTRAN COMPILERS

The latest Prospero Fortran now supports OS/2 & DOS.
A new version of Lahey's compiler with improved optimisation now here.

Lahey F77L v4.10	MS-DOS	£410
Lahey F77L-EM/32v3 ergo+	PC-DOS	£665
Lahey Personal Fort-77	PC-DOS	£ 79
FTN77/386 Fortran	PC-DOS	£695
RM/FORTRAN 77 v2.43	MS-DOS	£445
MS-FORTRAN 77 v5.0	OS/2&MS-DOS	£250
Prospero Fort 2.10	OS/2&MS-DOS	£240
Pro Fortran for GEM	MS-DOS	£ 80
Prospero PC Fortran	PC-DOS	£ 80
Utah Fortran	MS-DOS	£ 35
FS-Fort.(CGA & Herc)	MS-DOS	£ 34
Watfor 77	PC-DOS	£290

We have Fortran Libraries in stock.

GREY MATTER
2 Prigg Meadow, Ashburton, Devon TQ13 7DF
TEL. (0364) 53499

GREY MATTER
2 Prigg Meadow, Ashburton, Devon TQ13 7DF
TEL. (0364) 53499

GREY MATTER
2 Prigg Meadow, Ashburton, Devon TQ13 7DF
TEL. (0364) 53499

CIRCLE NO. 376

Windows Show
The Windows Show will be held on Feb 12th-14th 1991 at Olympia 2, London. It is to include a Windows Developer's conference, with speakers brought in by Microsoft. Further information from IT Events on 0256 83456.

Prolok missed
In our grand survey of software protection schemes, we omitted the Prolok software protection scheme, which is marketed in the UK by the Prolok Company (02406 2358). Our apologies to the company, which also offers ROMLOK-P (which is a dongle) and is on the point of releasing a software package which, it claims, will provide generic access control for LANs.

MS-COBOL
Microsoft has released V4.0 of its MS-DOS and OS/2 COBOL compiler. Based on Micro Focus COBOL V2.4 compiler engine, the package comes with the Programmer's WorkBench V1.1 (complete with help files containing syntax diagrams for the whole COBOL language), the usual extra tools (but note that this CodeView only runs under OS/2; another debugger is supplied for MS-DOS work) and SQL Server support. The package costs £550.

UK base for PDC
PDC Prolog used to be 'Turbo Prolog', and it is made by a Danish company. Intellisoft (0753 889972) has just been appointed UK distributor for the product, which has come on since its Turbo days. As well as the MS-DOS version (£119), you can now buy an OS/2 version (£595), an SCO UNIX version (poa) and a Prolog Toolbox (£125).

Gas into CASE
British Gas has created a subsidiary, Information Architechs, to market a new CASE tool called 'Architech' (geddit). The product was originally developed for in-house use, and runs under non-GUI GEM on MS-DOS machines. A Windows 3 version will follow. Prices start at £125,000 for a 10 user system. Contact IA on 0753 831540.

Turbo Pascal V7.0?
Borland's explosive (literally) launch of Turbo Pascal 6.0 ended with some hints of future releases. There was a sneak preview of Turbo Pascal for Windows and Chuck Jaztzewski, Borland's star software engineer, mentioned in the last words of his speech that Borland was committed to support 'other operating systems' in the future. Hmmm.

Microsoft opens Windows

Microsoft is to publish the internal data formats used by its Windows programming environment. With the next release of Windows, third party manufacturers, such as compiler-writers Jensen & Partners International (Modula-2, C) and Zortech (C++), will have access to the relevant documentation covering internal data structures, stack frames, object modules and so on. There will also be new APIs, designed to help tool developers to get inside Windows. Previously they were (in theory) obliged to do some rather heavy reverse-engineering on Microsoft's own Windows products.

Microsoft calls this strategy 'Open Tools', and hopes that it will encourage the development of a wide range of Windows tools such as debuggers, resource editors and so on. Developers will no longer need to buy the Microsoft SDK to develop Windows applications; they will be able to get by with an ordinary copy of Windows and a suitable self-contained Windows development product (eg Turbo Pascal for Windows or TopSpeed C++ for Windows).

Niels Jensen, Chairman of JPI, told .EXE: 'Great news for programmers, and good news for Application Development Tool suppliers such as ourselves. Microsoft's Open Tools strategy further endorses our commitment to provide programmers with a Windows capability across the TopSpeed range of languages.'

New PS/2s

IBM has announced a big batch of new PS/2s. Top of the range are two 80486-based machines: the Model 90, which costs from £8500, and the Model 95, from £8960. Both machines feature an exchangeable processor board (available at 25 MHz and 33 MHz), so it should be easy to upgrade when the 80586 comes out. They have 8 MB of 70 ns RAM on the motherboards as standard, expandable to 32 MB. The CPU can address this memory via its own 64-bit data path. Both systems access volume data (hard disk, CD-ROM drive etc) via a Micro Channel SCSI adapter, which has its own 512 KB cache. The minimum hard disk size is 160 MB and the larger machine, the Model 95, can accommodate up to 1.6 GB internally plus 2.24 GB externally. However, the feature probably of most interest to software developers is the new XGA video standard, built into the motherboard of the Model 90 and supplied as an MCA card with the Model 95.

The XGA, which was produced at IBM UK's Hursley site, offers a maximum screen resolution of 1024 by 768 by 256 colours, using 1 MB of video RAM. It also has a 'direct colour' mode, intended to give a near-photographic effect, which is 640 by 480 by 65,536 colours (which by my reckoning leaves 50 KB unaccounted for). All VGA modes are supported, and existing VGA applications (even those that access registers) should run unchanged. DOS applications that used the earlier 8514/A Display Adapter, and stuck to the published interface, will also run ok; but if you used the video registers directly or wrote an OS/2 non-PM application then you have had it. IBM has arranged the following set of device drivers: DOS V3.3 and DOS V4.0 (required for 8514/A emulation), Windows V2.11 and V3.0, OS/2 V1.1 and V1.3, SCO UNIX System V/386 Release 3.2 and AutoCAD Release 10.

The XGA board is a busmaster with its own processor. This can fetch and store information from main memory independently of the CPU, so improving the machine's overall performance. Features offered by the XGA include a cursor sprite and 'scissoring' - movement of on-screen data - ideal for speeding up WIMP operations. IBM is to publish the XGA register interface next year, so it looks as though XGA is set to become the next graphics adapter standard. For more information on the new PS/2s, tel (081) 995 7700

OS/2 V1.3 announced

Microsoft and IBM have released the low-memory upgrade to OS/2. The new package can now operate within 2 MB of RAM (3 MB if you want the Extended Edition add-ons), hard disk (sorry, hard *file*) use can be reduced with a new selective installation program. OS/2 V1.3 is also faster, with particular improvements in its LAN file-handling and printing. Intelligent Environments, the manufacturers of Applications Manager, ran some existing applications in a benchmark test, and estimate V1.3 to run applications around a quarter faster than V1.2.

As predicted, Adobe Type Manager is now implemented, with a few standard fonts thrown in *gratis*. And REXX is now packaged with Standard Edition as well as Extended, allowing it to be used as a standard macro language for stand-alone applications. All this is downwards compatible, so existing applications can take advantage of the new features. New APIs have been added to allow fine tuning of the new print spooler, and to control the drag/drop and spin button functions. Prices remain the same: £256 Standard Edition, £611 Extended.

S O F T W A R E S E C U R I T Y

With £1 Billion Worth Of Protected Software...

Rainbow Is The Safe Bet.

Software developers creating the latest applications for the IBM PC/XT/AT, PS/2 and compatible systems can now turn to the Software Sentinel range of hardware keys for the *first-class* in *world-class* software protection.

There's the best-selling SentinelPro, known worldwide for its virtually unbreakable security, its ASIC technology and its invisible operation.

A close relation, the Sentinel-C for custom configurations, enables multiple package protection with a single device.

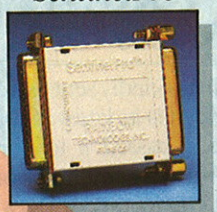
For the Apple market, security-minded Mac software developers can now secure their return-on-investment, too. Eve plugs into the Mac ADB connector and is completely transparent to the user–providing up to seven programmable security locks per key.

Rainbow's latest protection strategy is the SentinelShell–that lets users place a "shell" around existing, off-the-shelf programs. Access can be limited to those issued a key, so that libraries, educational establishments and corporations can very simply guard their investments.

Available soon from Rainbow is the DataSentry, a user-installed key that provides low cost security for sensitive data in both database applications and corporate/banking environments.

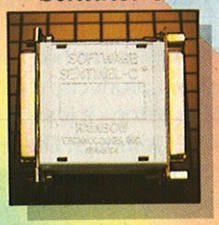
No matter where you sell your software worldwide, stay in control of your distribution and revenue by choosing the internationally accepted standard in protection... Rainbow Technologies. Be sure. Protect your pot of gold at the end of the rainbow.

SentinelPro™



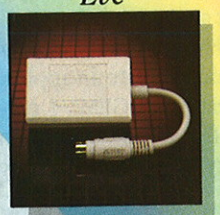
• Runs under DOS, OS/2 and Xenix • Algorithm technique (Never a fixed response) • External parallel port installation • Minimal implementation effort • Higher level language interfaces included • 100 times faster than fixed-response devices (1 ms) • ASIC design for reliability

Sentinel-C™



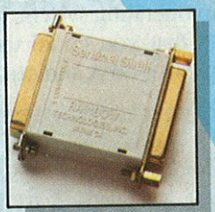
• Protects multiple packages with one device • 126 bytes of non-volatile memory programmed before shipment of the software • Rainbow supplies a unique adapter for programming the unit • Higher level language interfaces included • Runs under DOS, OS/2 and Xenix • External parallel port installation

Eve™



• For the Macintosh SE and II • Complies with Apple Desktop Bus Interface requirements • Rainbow-assigned developer passwords to prevent tampering by other developers or sophisticated "hackers" • 7 locks per key, usable individually or in combination, on one or up to seven applications

SentinelShell™



• Runs under DOS on IBM PCs and compatibles • Protects without requiring access to the source code • Completely transparent to the end user • User-friendly software • Pocket-size key attaches quickly to any standard PC parallel port • ASIC design for reliability

DataSentry™

• Completely user-installable • Pocket-sized external device • Menu-driven, user-friendly interface • Single- or multi-user security system • Audit trail, log-on identifiers and automatic encryption/decryption of entire directories • Secures data transmitted by modems • Prevents recovery of data by utility programs

CALL TODAY OR ORDER NOW.

☐ Please send me a SentinelPro Evaluation Kit.
I enclose £50 + VAT Payable to Rainbow Technologies Ltd.

☐ Please debit my credit card. Access ___ Visa ___ Amex ___
Expiry Date _____ (PLEASE TICK)

☐ Please send me more information.

Name _____

Position _____

Address _____

Telephone _____

Signature _____ .EXE 12/90

RAINBOW TECHNOLOGIES LTD., Shirley Lodge, 470 London Road, Slough, Berkshire SL3 8QY.

RAINBOW TECHNOLOGIES

Shirley Lodge, 470 London Road
Slough, Berkshire SL3 8QY
Tel: 0753-41512 Fax: 0753-43610

©1989 Rainbow Technologies. All product names are trademarks of their respective manufacturers.

CIRCLE NO. 377

USXC

USXC is a German-written real time multi-tasking executive distributed by Creative Data Systems (0256 840646). Targeted at 8086, 8051, 8096, 68000, 68020, 68HC11 and Z80 processors, it offers dynamic task and resource management, plus inter-task communication. The software is configurable, ROMable, is supplied as C code as well as assembly and compiles to just 3 KB of object code. The price is £1680.

Prolog update

Following our piece on ESL's Prolog-2 for Windows 3, we've had a note from Quintec Systems Ltd, pointing out that its professional Prolog development system is also now out in Windows 3 form. Chief boons are a full DDE link system, and expert system and OOP toolkits. Quintec can be contacted on 0865 791565.

Now they're giving it away

Academics can, if they hurry, get hold of a free Ada compilation suite for their Sun-3 or VMS systems. The offer comes from Tartan Inc, which will provide colleges or universities with a full Ada compiler, the run-time system, a source-level debugger, cross reference-tool, object file utilities and a full set of documentation. Technical support is included, and the market value of the products range from $15,000 to $70,000. Offers are, unsurprisingly, limited and you have until December 31 to get them in. Phone John MacGregor at Thornbrook: (0993) 83133.

Dictionary Engine DLL

Microlytics are now shipping Spell Finder 7.0 for Windows, a spelling engine in DLL form. The library takes up 48 KB, and has support for all the major European languages. Included with package are a number of source code examples for integrating spell checking functions into external application code. Microlytics are on 0533 625062.

Qedit 2.1 For Sale

Fans of Qedit, the shareware programmer's editor by Semware, will be pleased to know that Grey Matter is now selling the fully boxed product in this country. The package includes complete printed manuals and registration card. Support from the US is reputably excellent, as with most shareware products, and there's an OS/2 version too. Qedit 2.1 Advanced costs £55 (DOS or OS/2 version). A DOS package including a TSR version of the editor is available for £69. Contact Grey Matter on 0364 53499, or try your local bulletin board.

OpenWindows Source

As per the season of goodwill, Sun Microsystems (0276 20444) has released the source code for its OpenWindows application development environment. This includes the full code of Sun's X11/NeWS system, the fully X compliant implementation of PostScript windows. Also included is the source of OpenFonts, Sun's non-proprietary font scaling technology (including 57 scaleable Folio fonts), and Sun's implementation of the OPEN LOOK toolkit.

The source is available entirely free of charge - you just pay for the media. Unfortunately, the media cost $995. Available from January 1st from your nearest Sun distributor.

Batch To The Future

Readers may remember an irate letter from a Mr Ian Butterworth in October, complaining about the current state of .BAT compilers in general, and Hyperkinetix's The Builder in particular. We've now discovered a compiler which seems to work as per Mr Butterworth's requirements. BATToCOM from a UK company Clockwork Software implements all the standard DOS and BATCH commands, as well as supply a number of extra functions, such as large display fonts and simple windowing. It is limited (as the name suggests) to 64 KB of code, but can support overlaying. There's no copy license required for compiled code. It costs £65.

Clockwork has got a few other DOS utilities up its sleeves, including a redundant code analyser called FOSSIL and a rather good memory editor called MAP. My favourite is its empty disk space analyser HAVEWE, which has the syntax 'HAVEWE 300K on B:?'. FOSSIL and HAVEWE cost a tenner each, and MAP is priced at a very reasonable £25. Clockwork is on 0705 483217.

GEM Sour Grapes

Digital Research has kindly sent us a copy of Artline V2.0, which is its latest PC-based graphics package. I passed it to our Art Department, and she reports that it is pretty good (better than GEM Draw or DrawPerfect), although a little slow. She particularly likes the powerful colour-blending features and the ability to make text follow curved lines.

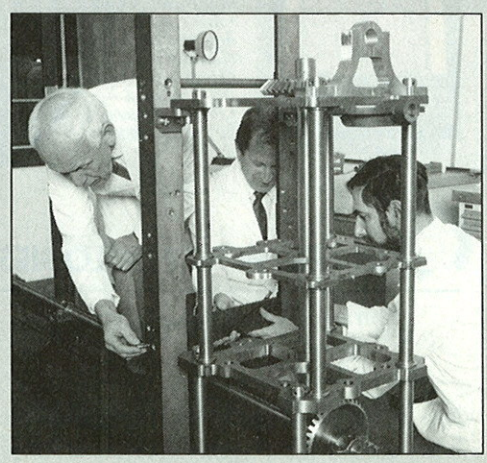
Artline is a GEM application but, unlike previous DR graphics products, it is not bundled with GEM Desktop - it is to be sold as a 'DOS' application. Although DR denies that it is dropping GEM, any developers still using it will hardly be encouraged by the following extract from the DR press release: 'Why is there so much confusion about [Microsoft] Windows and GEM? Simply because GEM is not a GUI whereas Windows V3.0 is a GUI. GEM is a library of routines that can enable you to create an application that uses GUI features.' 'GEM', I may remind you, stands for Graphics Environment Manager. A fancy name for a library, or what.

Artline V2.0 costs £395 and is available now. Upgrade deals available include... hold on, some late news just came in: CP/M, was not after all an operating system; just a library of routines that you could use to access files. BDOS Error on A and out.

Babbage's Engine

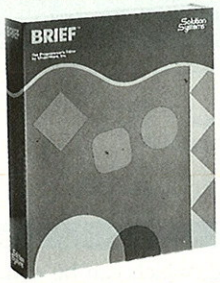
The Science Museum in London is playing host to an attempt to construct, for the first time, Charles Babbage's Difference Engine No 2. Next year is Babbage's bicentenary, and the museum intends to celebrate with a special exhibition, beginning in July, with the working Difference Engine as the centre-piece. The opening of the exhibition will coincide with a special International Conference on Computing, held under the auspices of the Institution of Electrical Engineers at Imperial College, London.

Babbage's own attempt to build the engine, which was ended by the withdrawal of his sponsorship, was previously thought to have been doomed because of the impossibility of manufacturing mechanical parts to the required tolerances. The current £500,000 project, which is sponsored by a consortium of computer, electronic and communication companies, seeks to prove this theory wrong, and so redeem Babbage's image. They are still looking for extra sponsors, by the way; if you're interested call Lynn Foster on 071 938 8115.



U.K. VERSION
NOW SUPPORTS BOTH DOS & OS/2, DUAL MEDIA

POWER AND FLEXIBILITY



BRIEF 3.0 increases your productivity for just £199.00*

*VAT extra, FREE delivery

BRIEF has established itself as the leading programme editor on the market today. Now, with the launch of the latest enhanced version – BRIEF 3.0 – it offers even better productivity.

ENORMOUS UNDO POWER

BRIEF 3.0's enhanced UNDO capability takes the fear out of programming. BRIEF 3.0 allows you to undo any command that affects the cursor or the text (including global changes) up to 300 times, even back to the beginning of your session. It's the safety net you need to program with confidence.

REAL FLEXIBILITY

There's built-in support for 36 languages including Assembler, BASIC, C, COBOL, dBase, FORTRAN and Pascal. And thanks to its complete macro language you can make BRIEF 3.0 fit your own programming style with ease: change key assignment, commands, prompts, colours – even the indenting styles.

BRIEF 3.0 – new benefits

- With our new C-like macro language, CBRIEF, C programmers can write macros on the fly and not have to switch between C and a different macro language
- The new source level debugger works with both the original BRIEF syntax and the new CBRIEF macro language
- Maximum lines per file has been increased to 4 billion
- We've added to and improved template editing and smart indenting for ADA, Cobol, Basic, Fortran, Modula-2, Pascal and C
- We've added editable, multiple keystroke macros that can be saved and restored
- You can even save and restore your window set-ups

Plus the features that made BRIEF famous

- Flexible windowing
- Unlimited number of files
- File size limited only by desk space
- Regular expression search and replace

No other editor puts this much power and flexibility in your hands. So if you're looking for extra productivity purchase your copy of BRIEF 3.0 today.

Solution Systems

SOLUTION SYSTEMS are the UK distributors for BRIEF 3.0. When you buy from us you get the authorised UK version of BRIEF 3.0 dual media (3½" and 5¼") plus bonus macro diskette.

Special phone line for Access/Visa card holders. Save time by phoning 0763 244141 between 9.00 and 6.00 Monday to Friday to placeyour order.

N.B Official purchase orders from local authorities, PLCs and educational establishments are accepted by post or by Fax.
Fax no: 0763 244025

BRIEF 3.0 The Programmer's Editor

Send to: Solution Systems UK, The Maltings, Green Drift, Royston, Herts SG8 5DB

Please rush me my copy of BRIEF 3.0

☐ I enclose a cheque to the value of £228.85 (£199 + V.A.T.)

Orders despatched same day.

NAME ADDRESS

POSTCODE

Please charge my Access/Visa* account by the sum of £228.85 (£199 + V.A.T.)

Card No: Expiry Date: Signature:

.EXE 12/90

* Delete as appropriate

CIRCLE NO. 378

Busman's Holiday
Two conferences abroad that might be interesting to those of you who can swing the costs. Software Development '91 is the big Silicon Valley meet, with three days of intensive discussion with the likes of Stroustrup, Plum and Kahn, and exhibits by most of the big American developers. Cost (excluding accommodation): $895. Tel: 0101 415 995 2472 for details. Nearer (but not much nearer) is the popular International Workshop on Software Engineering, at Toulouse. Registration cost is 4,700 French francs. Tel :01033 1 5780 7000.

Mea culpa, Stony Brook
Apologies to readers raring for Stony Brook Pascal+ info. The truncated phone number given last month left contactees in mid-Atlantic. Stony Brook's full number is 0101 805 496 5837 - sorry.

£30 Modula-2 for the Macintosh
Real Time Associates (081 656 7333) is now marketing a Metrowerks Modula-2 compiler for Macintoshes for £29. The package includes a full optimising 68000 compiler with debugger. Standard Modula-2 implementation of I/O is included, as are a few limited graphics modules. Modules are limited to 1000 source lines. Mac users looking for a full MacApp-like support, with 68030 and co-processor compilation, should splash out on the full £150 system.

Hypertext compiler
A program which converts documentation into a pop-up hypertext system has been announced by Mike Lewis Computing (031 667 7685). The FactBox compiler takes simple text files with flagged cross-references, compresses it, resolves the cross-references, links the topics to an outline, and adds a help screen. Mike Lewis already produce an MS-DOS encyclopedia based on the system. A basic FactBox Compiler sells for £95, but you'll have to negotiate with MLC for copy licence conditions.

Giftware
Something for the WIMP in your family. Mickey Mouse, Dick Tracy and Indiana Jones(TM) Mouse Pads. £13 each from the MacWarehouse, Tel:0800 181 332.

Our No-Nonsense Christmas Warranty
Finally, a reminder that .EXE hibernates in January, so please do not ring us up to query its non-arrival. Meanwhile, we should like to thank our readers and our advertisers for their support over the year, and wish you all a Merry Christmas with a Happy New Year, subject to the usual conditions.

Assembly Help

One of the many pains of assembly language coding is that any macros one writes never seem general enough for regular use. Apart from <K>POP_ALL<k>, and a smattering of maths functions, it hardly seems worthwhile. Quantasm has just released a small macro and support library which should bear reuse. It's called 'PRINTF for Assembly Language' and that is pretty well what it does. It takes up less than 600 bytes of code, and comes with a flexible macro structure. PRINTF can format and print 32-bit, 16-bit and string data, with hexadecimal, signed and unsigned conversions (see our examples). The source code can also be easily modified to support user data types.

Quantasm has also released an update to its assembly code flow-charter, ASMFLOW Professional V2.0. Extensions to the old ASMFLOW include better macro support, a larger capacity for tree diagrams, 486 code and a hitch in price to $199.95 ($49.95 to old ASMFLOW users). Quantasm Corp is on 0101 408 244 6826.

```
printf    <Hello world.\n>
printf    <AX=$x BX=$x\n>, <ax,bx>
printf    <FIlename: $s[11]\n>,<ds,si>
printf    <File size: $lu\n>,\
               <[si].size.hi, [si].size.lo>
```

The Portable COBOL

Ryan McFarland has announced an upgrade of its RM/COBOL-85 compiler. Version 5 offers pop-up windows (which is more difficult than it sounds, on the diverse range of platforms that RM inhabits) and additional X/Open features. The software now supports some extensions from various other COBOL dialects: `Read Previous`, `Start Less Than` and `Or Equal` come from IBM VS COBOL.

The product uses a pcode system to attain easy portability. It is initially available on the IBM RISC/6000, MS-DOS, OS/2, SCO UNIX and 88000 based systems, with others to follow before the end of the year. The price for the MS-DOS development system is £1040; the run-time pcode interpreter costs an extra £125 for a single user version. Ryan McFarland is now part of Liant Software Ltd, which can be contacted on 071 799 2434.

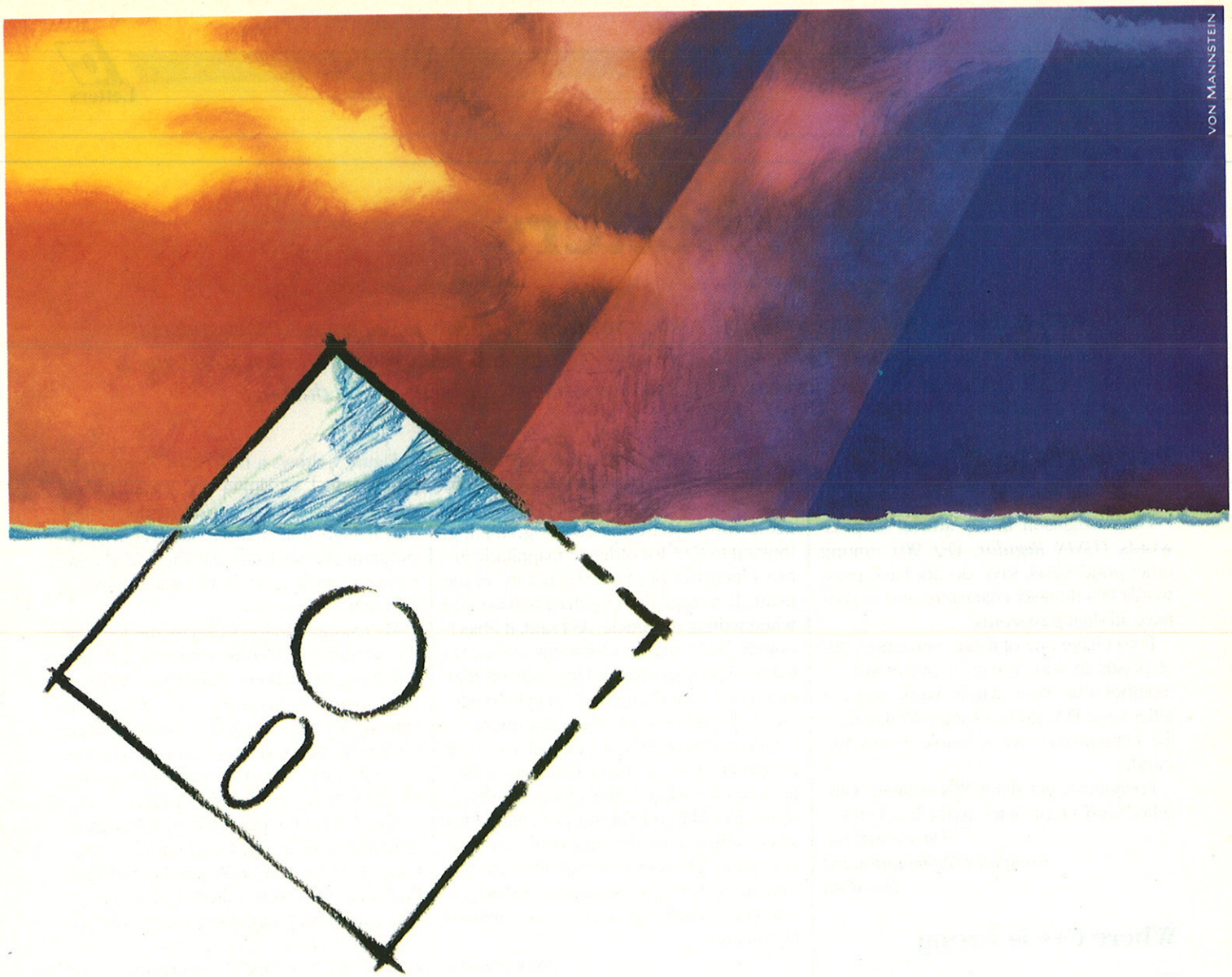
Windowsmania

Just to put it all in perspective: Windows 3 has now surpassed 1.5 million sales (2.5 million, including OEM bundling). The UK accounted for over 60,000 shipments. According to Microsoft, seven out of 10 new software applications are designed for Windows, and more than 25,000 Windows SDKs have been shipped. A telephone survey by Sapphire International showed that 12.5% of those polled intend to install Windows instead of OS/2. Over 20% are already using Windows. Altogether, 45.2% of the total survey were users or expected to use Windows, against only 8.6% who were users, or planned to be users of OS/2. Microsoft's profits this quarter were up 77%.

Pop Star

The winner of our POP-11 competition (as drawn from the Editor's hat) was Mr D A Darlison of Dewsbury. Congrats to Mr Darlison; the copy of *The Annotated C++ Reference Manual* is on its way to you. The runners-up were Bill Tromans from St Albans, Peter James from Walsall and Mark Davies from Rowington: T-shirts go to each of them. Commiserations to the many other entrants.

The 11 items in the POP picture were: Pop[1] the paternal figure is popping[2] the champagne and popping[3] his clogs. The nursery-rhyme weasel is certainly reputed to pop[4], and it has a pop-gun[5]. A balloon is popping[6]. There is a bottle of pop[7] and a bowl of popping[8] breakfast cereal on the table. The TV is tuned to *Top of The Pops*[9], and a pair of pop-socks[10] is drying on the aerial. Through the window, we can see a pawnbroker's sign, suggesting that we are near a pop[11] shop. So now you know.



What you know about Clipper so far is only the tip of the iceberg.

▶ And since Clipper is used by more than 250,000 developers to write PC applications, chances are that you already know many of its advantages. Like its blazing speed, its royalty-free distribution and its full support for network applications. Plus user-defined functions allowing C or other languages to be used. And an open architecture so you can channel your creativity into writing applications rather than solving shortcomings in your development system. ▶ But now Clipper 5.0 gives you even more. Like automatic memory management by a new linker which eliminates the need for overlaying . So you can run Clipper programs which are much bigger than the available memory. Like multi-dimensional arrays. Like user-defined commands providing compatibility with other data base management systems. Like on-line documentation. Like there's full support for expanded memory. And all this backed by the sort of support that developers are entitled to. ▶ For a free Clipper 5.0 information pack (with details of upgrades for registered users) please clip the coupon. ▶ And once you've taken a look at what else is in Clipper 5.0, you will find it difficult to stay cool. *Nantucket UK Ltd, 8 Bridgegate Centre, Welwyn Garden City, Herts. AL 7 1JG. Tel. 0707 373 600. Fax. 0707 373 350. Also offices in Cologne, Tokyo and Los Angeles.*

Name

Position

Company

Address

Phone

EXE 12.90

Nantucket®
FULL POWER

Clipper and the Nantucket logo are trademarks of Nantucket Inc.

CIRCLE NO. 379

Letters

We welcome short letters on any subject that is relevant to software development. Please write to The Editor, .EXE Magazine, 10 Barley Mow Passage, Chiswick, London W4 4PH. Unless your letter is marked 'Not for Publication', it will be considered for inclusion on this page.

Passwords for Plastic

Sir,

Peter Collinson in his article on passwords *(UNIX Regular, Oct 90)*, among other good ideas, says 'do not have passwords less than six characters' and 'do not have all digit passwords'.

If you have one of those convenient bits of plastic in your wallet or purse, just remember that your whole bank account relies on a FOUR DIGIT PASSWORD, and the keypad you use is visible to any bystander.

I religiously get all my PIN numbers cancelled with a nasty letter to the head office.

Dave Fawthrop
Computer Hyphenation Ltd
Bradford

Where C++ is wrong

Sir,

Contrary to Dr Bailey's suspicions *(Letters, October 1990)*, I am not a supporter of any particular object-oriented programming language; I always favour the language most suited to the job. If, like Dr Bailey, I wished to write compilers I, too, would probably choose C++.

But there is something deeper than this issue of horses-for-courses. Dr Bailey is clearly someone who, quite correctly, regards C++ as a better C and has little ambition beyond exploiting its improved powers of abstraction and encapsulation. He should be aware that there are many organisations, hyped-up by the claims made for object-oriented programming, looking to C++ for order-of-magnitude improvements in productivity. It was, in the main, these organisations that I had in mind when writing my article. As I said, if object-oriented software development can live up to this hype no particular language will play much of a part; changing the development life-cycle will be vastly more important.

One company I know of which has been pondering C++, a major financial institution, has a background of software development in APL and Natural, both high-level environments easily accessible to programmers. The idea of companies like this moving to C++ just because of its object-oriented cachet is enough to give anyone nightmares.

John Daniels
Object Designers Ltd
Herts

FORTRAN fan

Sir,

I have followed with interest the series *The Third Side*, but was rather surprised to see the sample program shown for FORTRAN in .EXE Magazine August 1990. On reading the article, I realise that this was meant to be a version in the original FORTRAN.

Figure 1 shows a FORTRAN 77 program equivalent. I sat down and coded it, because I felt that any casual reader of the article might think that a modern FORTRAN program would look like the *Third Side* example shown, while the reality is very different.

My example follows exactly the logic of the previous FORTRAN solution, with the following exceptions. The first test (for a valid triangle) rejects the cases where the sum of two sides is equal to the third since this results in a collapsed triangle which is a straight line. Also the read has been revised to use an 'implied DO' loop.

This is the only place where the array `T` is treated as such, and it would probably be easier to code and understand correctly if the three sides were called '`A, B, C`' or '`X, Y, Z`'; although modern practice would encourage `SIDEA, SIDEB` and `SIDEC`. One of the features of FORTRAN is that spaces are ignored anywhere within code, except in character constants. Although this has some bad side-effects, it means that you can refer to `SIDEA` as '`SIDE A`', which may be more readable (but confuses editor searches on variable names).

The current draft standard (FORTRAN 90 - no longer known as '8X') introduces a number of other features which remove the arbitrary restrictions of FORTRAN; eg free format source code with significant blanks (so no more `SIDE A`). There are also many major enhancements, such as array handling; derived (user defined) data types including structures; pointers and program modules (packages) which are planned for the latest standard. These will make FORTRAN a winner for parallel processing of large array computations and provide most of the 'modern' features of other popular languages, with fewer dangers.

FORTRAN continues to be, and increasingly to become, a pragmatic, effective and readable language in which to write clear, efficient and maintainable code.

George A Ruscoe
Humphreys & Dean
Software Consultants

EXE

```
* This program tests for a valid triangle

      PROGRAM TRIANG

      REAL       T(3)
      PRINT *,'Enter lengths of 3 sides'
      READ *,(T(I),I=1,3)

      IF (T(1).GE.T(2)+T(3).OR.T(2).GE.T(3)+T(1).OR.T(3).GE.T(1)+T(2)) THEN
        PRINT *,'This is not a Triangle'

      ELSEIF (T(1).EQ.T(2).AND.T(1).EQ.T(3)) THEN
        PRINT *,'This is an Equilateral Triangle'

      ELSEIF (T(1).EQ.T(2).OR.T(2).EQ.T(3).OR.T(3).EQ.T(1)) THEN
        PRINT *,'This is an Isosceles Triangle'

      ELSE
        PRINT *,'This is a Scalene Triangle'
      ENDIF

      STOP 'Done'
      END
```

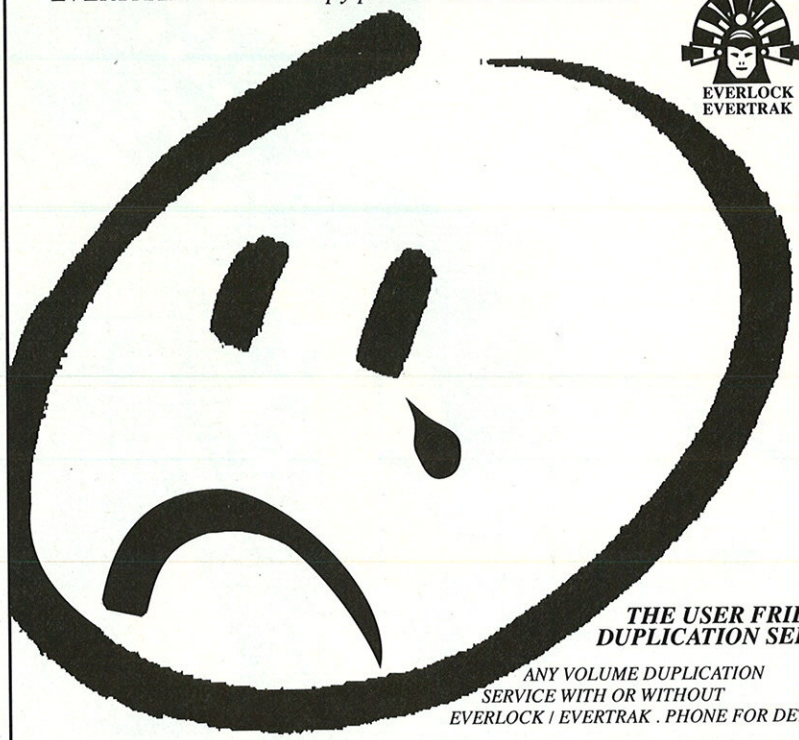
Figure 1 - FORTRAN 77 solution of Triangle problem

"AS YOU LIKE IT!"

Copy Protect AND/OR Copy Register...Don't give it away & cry!

EVERLOCK: Stops copying & controls programs as you want it.

EVERTRAK: Does not copy protect but it does control.



EVERLOCK
EVERTRAK

EVERLOCK

- COPY PROTECTS YOUR PRODUCT
- POSITIVELY SECURE AGAINST 'BIT-COPY' SOFTWARE
- PREVENTS DE-BUG, TRACING & DISASSEMBLY
- SUPPORTS ALL HARD & FLOPPY DISC FORMATS
- COMPATIBLE WITH MOST NETWORKS
- OPTIONAL RESTRICTION OF NETWORK USAGE
- LIMITS PROGRAM USE BY EITHER NUMBER OF DAYS AND / OR EXECUTIONS
- REMOTE RESET OF INSTALL, DATE, EXECUTIONS
- SUPPLY UP TO 99 INSTALLS ON ONE DISC
- NO DAMAGED MEDIA OR NON STANDARD 'DOS' ACCESS
- SUBSTITUTE I.O. PLUG FOR SOFTWARE
- END USER TRANSPARENT
- EASY PRODUCT UPGRADE
- "SECURE STRING"- EG. USER REGISTRATION / SERIALISATION

EVERLOCK NEW RELEASE EVEN MORE POWER

EVERTRAK

- NON - COPY PROTECTION OF SOFTWARE
- AUTOMATIC PRODUCT SERIALISATION / REGISTRATION
- ANTI - REVERSE ENGINEERING
- OPTION TO ATTACH PASSWORD
- LIMIT NETWORK CONCURRENCY
- DYNAMIC PROGRAM COMPRESSION
- DYNAMIC PROGRAM ENCRYPTION
- END USER TRANSPARENT
- COMBINE EVERLOCK & EVERTRAK

EVERTRAK NEW RELEASE EVEN MORE POWER

THE USER FRIENDLY DUPLICATION SERVICE

ANY VOLUME DUPLICATION SERVICE WITH OR WITHOUT EVERLOCK / EVERTRAK . PHONE FOR DETAILS!

USER FRIENDLY MicroSystems

EVERLOCK & EVERTRAK SOLE DISTRIBUTION: U.K., S. IRELAND, SPAIN.

ICS House, Edward Street, Redditch, Worcestershire, B97 6HR. England. Tel: 0527 585 550 Fax: 0527 65111

CIRCLE NO. 435

PCX Effects & Text GRAPHICS! & COMMS!

Powerful Programming Tools for PC Paintbrush Image Manipulation

PCX PROGRAMMERS TOOLKIT £165

Incorporate graphics into your programs quickly and easily! The PCX Programmers Toolkit includes over 60 routines to display, save and print PCX bit mapped graphics from within nearly any program. Includes nine utility programs for capturing screens, displaying images, managing image libraries, and printing image files. Use graphics from PC Paintbrush, Scanners, Fax Machines, Clip-Art or captured screens.

PCX EFFECTS £85

Add Spectacular Special Effects (F/X) to your programs, without being trapped in someone else's editor or slideshow program. Wipe, split, crush, slide, sand, drip, diagonal, spiral, random, EXPLODE your graphics!

PCX TEXT £155

Now display blazing bit mapped text in any graphic mode as simply as text mode!

PICTUREBOX £149.95

The perfect low cost Slide Show presentation software from Highland Grafix. Capture and Display Text and Graphics screens directly into your presentations. **INCLUDES Zsoft's PC Paintbrush IV Plus** for editing images or adding text overlays. Special Effects are also included so that you can add a professional finish to your display. A Runtime module is supplied with PictureBox so you may give away your Slide Show without any royalty fees.

All PCX Toolkits support 12 Compilers for 'C', Pascal, Basic, Fortran, Assembly, Modula 2, Prolog and Clipper. All modes of the Hercules, CGA, EGA, VGA and Super VGA adapters are supported, (30+ modes in all). Assembly and 'C' source code is optionally available. Trademarks are the property of their respective holders.

C COMMUNICATIONS TOOLKIT £149

Now you can add professional serial communications to any 'C' application. 'C' Communications Toolkit makes it fast and easy. You don't need to spend months writing, testing and debugging low-level device support, file transfer protocols and CRC routines.

POWER

Up to 115,000 bps. XON/XOFF, RTS/CTS, DTR/DSR, VT52, VT100, ANSI X3.64, ANSI. SYSFull DCA/Intel CAS FAX and File transfer. Receive, Transmit, Modem Status and Line Status Interrupts. Full Hayes com'd set + Telebit & UDS extensions.

FLEXIBILITY

Unlimited number of serial ports, any I/O address and IRQ line. Log output/input to a printer. Capture output/input to a buffer/file. Multi-port board support for AST, Digiboard, Commtech, Arnet etc.

FILE TRANSFER

Single file: ASCII, XMODEM, XMODEM-CRC, XMODEM-1k.
Multi-file: YMODEM, YMODEM-g, (error free links).
KERMIT (with run-length encoding & 8th-bit prefixing extensions).

COMMUNICATIONS CHIP SUPPORT

INS8250/A/B, 16450, INS16550/A (inc. FIFO buffers & interrupt threshold). Zilog Z-80 SIO/DART (async. SDLC, HDLC, BISync).

DOCUMENTATION

Over 200 functions. 600-page manual with 100 pages of Toolkit tutorial (build a powerful terminal program in easy stages), 25 pages of serial communications background and over 35 examples programs.

Supports MSC5.0 +/Quick C, Power C v1.2 +, Turbo C, Watcom C. Full source code included - No Run-Time royalties. 30 day Warranty.

Pinna Electronics Ltd., APL Centre, Stevenston, Ayrshire KA20 3LR. Tel: (0294) 605296 Fax: (0294) 68286

CIRCLE NO. 380

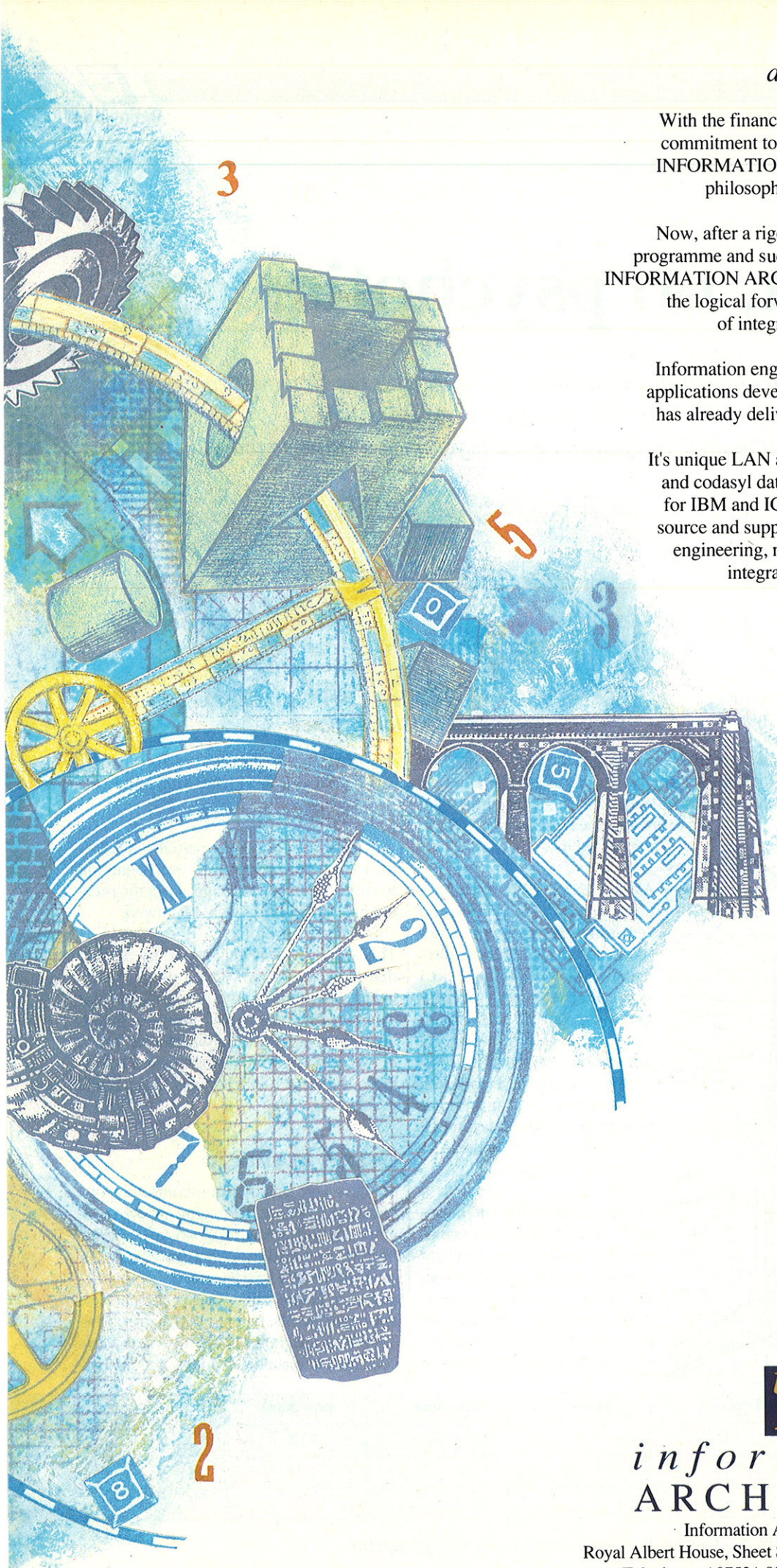
evolution;
progress to a higher form

evolution

Successful progress in any sphere depends on an understanding of the past and present. To extrapolate what can be achieved from the experience of what has been accomplished.

Innovation applied in a vacuum merely produces solutions looking for a problem; applied to the results and best practices of the real world it produces tangible progress.

Nowhere is this more true than in software development.



a higher form

With the financial backing of British Gas and a commitment to product and service excellence, INFORMATION ARCHITECHS embraces the philosophy of innovative evolution.

Now, after a rigorous 50 man year development programme and successful real world implementations, INFORMATION ARCHITECHS introduces ARCHITECH, the logical forward step into a new generation of integrated CASE technology.

Information engineering based and spanning the applications development lifecycle, ARCHITECH has already delivered complex working systems.

It's unique LAN architecture, support for relational and codasyl databases, ability to generate code for IBM and ICL systems from a single design source and support for forward and reverse data engineering, mark it out as a higher form of integrated CASE technology.

information
ARCHITECHS

Information Architechs Limited,
Royal Albert House, Sheet Street, Windsor, Berks. SL4 1BE.
Telephone: (0753) 831540 Fax: (0753) 831541

CIRCLE NO. 381

Wot, no psychotic?

In which Prof Darrel Ince admits to a narrow brush with the Demon Drink; he explains why IBM likes to employ hopeless gamblers and suggests what to do if you haven't got a psychotic in your company.

You may think that the story I am about to tell you has little relevance to testing. Please bear with me: the lesson it taught me helped me sharpen up my testing considerably. Even if you think it has little relevance, it does contain some humour.

I was brought up in a small village in South Wales. My family was very religious and consequently I had to attend chapel every Sunday rather a large number of times. Each Sunday I would be scrubbed and buffed, and sent to both the Sunday services and Sunday school. At all these events I had to listen to rather forbidding preachers who would deliver the same message week after week: that the fruits of the present and afterlife would only be gathered by those who worked hard. By the time I went to university, this message had been hard-wired into me.

a=3	b=4	c=5		Error 1	Display values
0		0			0
X	0			0	
0	0	0		0	
	X	X		0	

Figure 1 - A simple decision table

After university, I worked for a company which developed real-time software on mainframe computers, in those days a notoriously hard thing to do. I was given the task of programming one of the subsystems of a rather primitive transaction system using an assembler language. Debugging facilities were few and steam-powered. I found detecting all the errors in the system was an extremely difficult task.

I used to come in in the morning, on time, with my ham sandwiches, collect the printout from the previous night's run, and pour over octal dumps looking for errors. Because I believed that hard work would enable me to gather the fruits of the present life, I would work through lunch-time, printout in one hand, sandwich in the other.

This approach was only partially successful. I was working very hard, and beginning to suspect that the message about the present life and afterlife might be flawed.

This suspicion was heightened by the fact that I shared a room with a more experienced programmer, whose frequent habit was to take long, liquid lunches. In the afternoons he would lurch into the room, belch, glance over my shoulder and home-in on the error I had just spent four hours looking for.

Drunk in charge

So, here was I, with a non-conformist upbringing, beaten at debugging my own programs by a drunk. I ascribed his superior performance to the alcohol, and devised a programme of experiments to test this hypothesis. Fortunately, before I undertook any experiments, I mentioned my problem to a senior programmer. He told me that my colleague's amazing debugging skills had

command ok	d1 correct	d2 correct	d1>d2	no data	one date	no date	
O	O	O	X	X	X	X	
X							
O	X						

Figure 2 - Decision table for the AVERAGE program

nothing whatsoever to do with the beer, but had everything to do with the fact that he hadn't written the program.

The senior programmer said that developing software was very like giving birth to and bringing up a child: it is messy, uncomfortable and nothing useful seems to emerge for a long time. We tend to exhibit the same faults in the way we treat both our own software as we do our children. We have misconceptions about what they do, we think that they are perfect and we interpret their actions wrongly.

So the worst choice of person to debug a program, said this sage, is the person that wrote it. It is this precept that has guided me both in my teaching and as a consultant advising companies on quality assurance. My aim in this article is to describe some techniques to increase this independence: some of them are managerial, others are technical.

Black team

Probably the most extreme implementation of the maxim 'let somebody else test your software' is the *black team.* This is a form of quality assurance organisation adopted by some of the divisions of IBM. A black team is a collection of staff who are called in after system testing has finished, and before acceptance testing starts. Its main function is to ensure that system testing has been carried out thoroughly, and that acceptance testing will not be too big an embarrassment to the developer.

IBM has an enlightened employment policy. It considers that *everybody* that it employs - even individuals who might, in most companies, be regarded as completely incompetent - is capable of doing some job well. A black team often contains staff who have not succeeded in other areas of a company. One black team that I met contained a secretary who had crashed every word processor which she had been given; a programmer who spent most of his salary on stock-car racing; an analyst who had had a run-in with an IBM manager, and had subsequently developed a pathological hatred of all IBM managers; and a programmer who was undergoing therapy. They formed the ideal team to carry out system testing. They had no interest in the software they tested and each, in his or her own way, had a reason for testing a system to the extremes of its performance.

I asked some of the members of the team, 'What is a good test?' They told me that a good test was one which crashed the computer, and an excellent test was one which crashed the computer and made it inoperative for hours on end. The project managers at IBM hold out the prospect of a visit from the black team in order to encourage their staff to test a system more thoroughly than they would normally do.

He would lurch into the room, belch, and home-in on the error I had spent four hours looking for

Another American phenomenon is the bug bounty hunter. Small companies usually resident in California are paid to test a system. They are usually given a small retainer, with a bonus for each bug that they discover.

In the United Kingdom we are somewhat staid, and rely on independent quality assurance departments who attach staff to projects. Such departments usually have a separate reporting line to a senior manager. If a project manager is not doing a good job testing a system, retribution descends upon him from a considerable height.

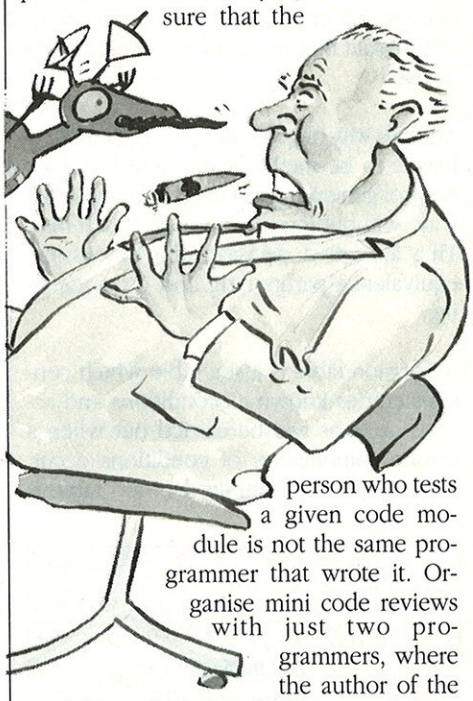
Small alternatives

Given that you might work in a small company without a quality assurance department, or you do not have a ready supply of psychotics, what can you do? There are a number of techniques that are available which, if they do not completely eliminate the bias that a software developer has in testing his software, certainly reduce it.

One of the most effective techniques is the technical review. A review is a meeting of software staff who examine a document or program code in order to detect errors. A code review would be a meeting of three or four staff who would systematically examine one module at a time looking for errors. They would not be involved in rectifying the errors, or suggesting corrections. Their job is simply to find fault.

Reviews sound awfully boring - they are - but they are immensely successful. At IBM, when they were introduced, they saved as much as 45% of project costs. The person who suggested reviews to IBM, Michael Fagan, received the largest bonus in the history of the company.

But what if your outfit is too small to use the full review process? There are still some practical measures that you can take. Make sure that the person who tests a given code module is not the same programmer that wrote it. Organise mini code reviews with just two programmers, where the author of the module explains, line by line, exactly how it works. It's really surprising how many errors are detected by the program's author without the listener so much as raising an eyebrow.



	comm error	date error	date diff error	no data error	one date error	results
						0
	X					
		X				

Figure 2 - Decision table for the AVERAGE program

However, if you are a *very* small project, or you are an individual producing software by yourself, or you are in the unlikely position of not being able to find a psychotic in your company, then the rest of this article is about generating high-quality test data which is almost guaranteed to crash any system.

Random testing

The first technique is random testing. If your program processes a large quantity of numbers or character strings, then use a random number generator to produce a large initial test-set. The advantage of using such a device is that a random number generator, as the name implies, is not biased by any human intervention. About five years ago, researchers at the Open University carried out a number of experiments to measure the effectiveness of random testing. During the experiment, which was performed on numerical software, (the sort of software used for simulating nuclear power stations or analysing the effect of wind on the wings of an aeroplane) the random number generator blew the software to pieces. It produced combinations of test data that no human tester had ever devised.

Another way of generating test data with no bias is to be methodical. There are three ways of generating test data in an organised way without introducing very much bias. They are called: decision table processing, equivalence partitioning and error guessing.

A decision table is just a table which contains entries known as conditions and actions. Actions will be carried out when a certain combination of conditions occur. An example of a simple decision table is shown in Figure 1. It has four entries. The first states that if the variable `a` is equal to 3 and the variable `c` is equal to 5, then some values will be displayed. The second entry states that if the variable `a` was not equal to 3 and the variable `b` was equal to 4, then error one would be displayed.

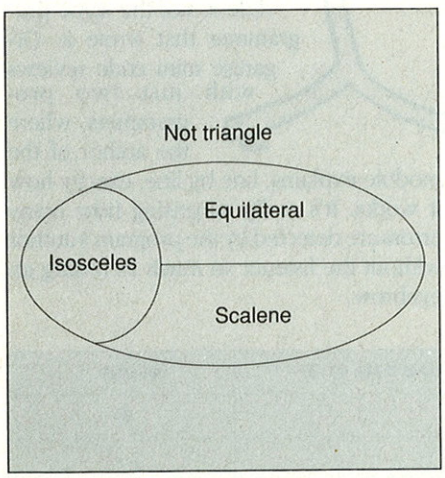


Figure 3 - Set of test data for the Triangle problem

Decision tables have had a long history. Originally, in the 1960s, they were used as a primitive programming language for commercial data processing systems. They were often implemented within COBOL compilers. For parts of a system which contained a large number of conditions and actions, a programmer would write a decision table in his program. A preprocessor would translate this into COBOL code, which would then be compiled as usual.

IBM considers that absolutely everybody that it hires is capable of doing some job well

Decision tables went out of fashion in the early 1970s. I don't know why - I had always regarded them as a neat solution to the problem of convoluted, over-complex code. However, they re-emerged a few years later in a way that shocked the computing community.

Two American academics, Jim Goodenough and Susan Gerhard, were interested in testing techniques. Around about the time that they were carrying out their research, there was a very heated debate over the merits of program proving and formal methods of software development. Proponents of mathematical software development were fond of stating that program proving (writing down a mathematical specification and then proving that a program implemented it) would render most testing obsolete.

Proof not Goodenough

Gerhard and Goodenough devised a testing technique using decision tables, and then generated test data which checked out a number of published programs which a number of researchers had proved correct. The results were devastating. Almost all the programs failed under test. Goodenough and Gerhard's technique was so effective that it crashed high-quality programs that were the product of a lot of effort.

Their technique is a very low-tech one. All it involves is the tester identifying all the conditions that could occur when a particular feature of a computer system is exercised, and then exhaustively generating test data by examining all the possible combinations of events in the table. As an example, consider the test of a command that finds the average of a set of data which has been gathered over a particular period. Let us assume that when a user types the command

```
AVERAGE date1, date2
```

the average of the data collected between `date1` and `date2` will be displayed on a VDU, where `date1` is chronologically earlier than `date2`. The events that could occur with this feature are:

- The command name could be typed incorrectly.
- The first date could have the wrong format. For example, there could have been a reference to the 35th of September.
- The second date could have the wrong format.
- The first date may be chronologically later than the second date.
- The second date may be chronologically later than the date on which the command was typed.
- There may be no data collected for the period between the dates.
- Only one date was typed in.

An example of a fragment of a decision table showing some of these conditions and the actions that should be taken is given in Figure 2. It is interpreted as follows. Each condition row will either contain a zero, a cross or be blank. If a zero occurs then the condition is true, if a cross occurs then the condition is false and if blank, then it is irrelevant that this condition occurs. Similarly, action columns will contain zeros, and blanks. If a zero occurs, then the action is carried out; if a blank, then the action is not carried out.

Each row of this column represents a specific test. For example, the first row states that if the command was typed in correctly, the first date (*d1*) was correct, the second

BRAIN BOX

From inspiration to application – the brightest way

BORLAND'S new **Turbo Pascal® 6.0** with **Turbo Vision™** is the World's Number One Pascal compiler. Now you can concentrate on functionality and performance, rather than spending time on program mechanics and interfaces.

Turbo Vision is a revolutionary object-oriented application framework for MS™-DOS. There's no need to keep writing and debugging interface code – eliminating the risk of introducing new bugs to a proven sub-system. Turbo Vision brings a rational approach to program design with its single architectural structure.

Even better, **Turbo Pascal 6.0 Professional** gives you not only a Turbo-driven compiler that fully uses your extended memory, but also the World's fastest 100% MASM-compatible assembler, the World's first interactive profiler, and **Turbo Debugger® 2.0**, which supports OOP.

If all that doesn't make you think, think about this too! Turbo Pascal 6.0 Professional retails for a remarkably competitive £199.95 plus VAT, and Turbo Pascal 6.0 for £99.95 plus VAT. And that's not all – if you're an existing Turbo Pascal user, take advantage **now** of Borland's very special upgrade offers.

For more information, contact your Borland dealer, ring Borland Customer Services on 0734 320022, or send the Freepost coupon today.

You'll never make a smarter move!

BORLAND
SOFTWARE
KNOW HOW

CIRCLE NO. 382

Borland International (UK) Ltd
8 Pavilions, Ruscombe Business Park
Twyford, Berkshire RG10 9NN Telephone 0734 320022

From the makers of Paradox®, Quattro® Pro, Sidekick®, Turbo Pascal® and Turbo C++®

All Borland products are trademarks or registered trademarks of Borland International. Other brand product names are trademarks of their respective holders. Copyright © 1990 Borland International Inc.

NAME _____

JOB TITLE _____

COMPANY _____

ADDRESS _____

_____

POSTCODE _____ TEL _____

I currently use Turbo Pascal ☐

EXE 12/90

Please return this coupon to: Turbo Pascal 6.0 Information, Borland International (UK) Ltd, FREEPOST RG1571, Twyford, Berkshire RG10 8BR

"With or without a mouse, it's the cat's whiskers."

New development environments and technology transition make 80's editors inefficient and obsolete. To be competitive, programmers must have leading edge tools. The tool you'll use the most, the one that wraps everything into a single consistent environment will be the powerful, configurable SPE Professional Editor.

Right out of the box, it'll make you more productive, more adaptable, more imaginative. Its instant installation, elegant mouse support, advanced user interface, and point-and-shoot help get you running immediately.

MS-DOS, OS/2 and Dual Mode together

MS-DOS, OS/2 and Dual Mode versions are all included in the same box on both 5¼" and 3½" disks, with templates for popular languages, with or without a bundled Microsoft® Mouse. Great value, and your team can move into the 90's with the same editor.

Turnkey emulations

If you prefer the commands and keystrokes of a popular editor, our turnkey emulations duplicate them precisely. And you still gain the SPE Professional Editor's advanced features, windowing capabilities and powerful engine.

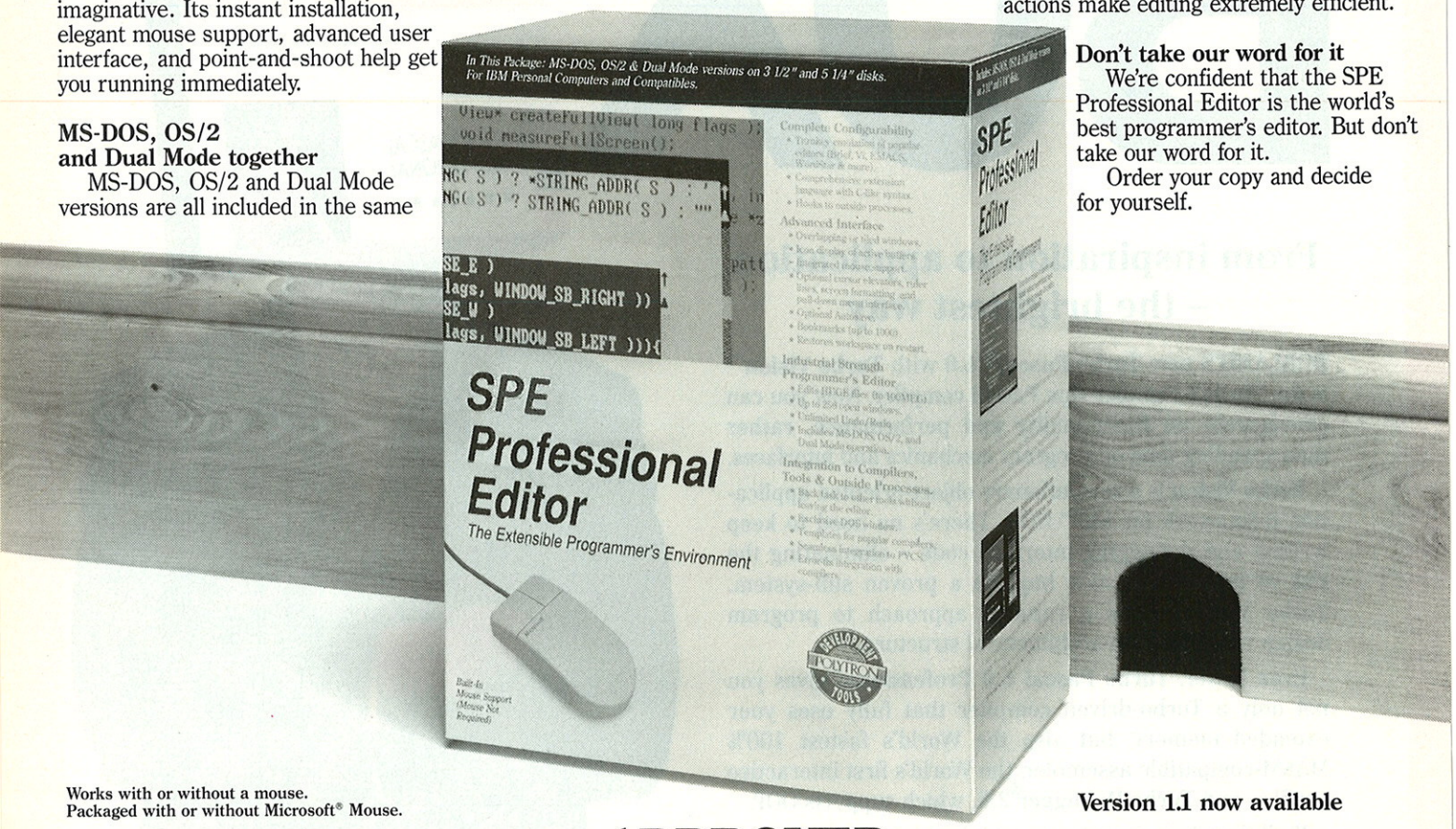
With or without a mouse

Use the editor with or without a mouse — all functions are available without lifting your fingers from the keyboard. But the click-select windows, scroll bars, zoom, shrink-to-icon, block text selects, and other speedy mouse actions make editing extremely efficient.

Don't take our word for it

We're confident that the SPE Professional Editor is the world's best programmer's editor. But don't take our word for it.

Order your copy and decide for yourself.



Works with or without a mouse.
Packaged with or without Microsoft® Mouse.

Version 1.1 now available

APPROVED DEALERS

Software Paradise
Avenue House, King Edward Avenue
Caerphilly Mid Glamorgan CF8 1HE
Tel: (0222) 887521

Computer Solutions Limited
Canada Road, Byfleet
Surrey KT14 7HQ
Tel: (09323) 52744

Grey Matter Limited
Prigg Meadow, Ashburton
Devon TQ13 7DF
Tel: (0364) 53499

Roundhill Computer Systems Limited
Orchard House
Ogbourne St. George,
Marlborough, Wiltshire SN8 1SU
Tel: (0672) 84535

Reflex Technology Limited
9 Buckingham Place
Bellfield Road, High Wycombe
Bucks HP13 5HW
Tel: (0494) 465907

Frontline Distribution Limited
Intec 1, Wade Road, Basingstoke
Hampshire RG24 0NE
Tel: (0256) 463344

System Science
3-5 Cynthia Street
London N1 9JF
Tel: 071-833 1022

Software Express
Portmill House, Portmill Lane,
Hitchin, Herts SG5 1DJ
Tel: (0462) 422525

Software Generation • Portmill House, Portmill Lane, Hitchin, Herts SG5 1DJ

CIRCLE NO. 383

date (*d2*) was correct, that data was available between d1 and d2, and two dates were typed in, then their results will be displayed.

These tables are produced from the system specification: the document that describes the properties of the system to be developed. As well as being an exceptionally good way of developing system tests, the technique is a thorough check of the system specification. Developers who use it to produce tests have reported to me that, by exhaustively moving through the table looking at combinations of conditions, not only are they able to create a good initial test set, but also find massive holes in the system specification.

n = 3	x at position 17	decision table
n = 50	x not in array	decision table
n = -1		error guessing
n = 11000		error guessing
n = 0		error guessing
x largest integer on computer		error guessing
n = 1	x at a[1]	error guessing
n = 1	x not at a[1]	error guessing
n = 23	x at a[23]	equivalence partitioning
n = 23	x at a[24]	equivalence partitioning
n = 100	x at a[100]	equivalence partitioning
n = 100	x at a[99]	equivalence partitioning
n = 100	x not in a	equivalence partitioning

Figure 4 - Testing the FIND program

Error guessing

A second technique is called *error guessing*. This involves the tester thinking of outrageous values for test data which would normally be regarded as an error. These are often the values that the user inputs first before they have properly read user documentation, or values which, although they might occur frequently, haven't been catered for in the software, and often blow it to pieces.

For example, a program for sorting integers could be tested by error guessed data which contained:

- Alphabetic characters.
- The largest integer capable of being stored on the computer.
- The negative of the largest integer that can be stored on the computer.
- A number which contains a large number of zeros.

And so on.

A final strategy is called *equivalence partitioning*. It is easiest to explain this technique with an example - the famous .EXE Triangle problem, which accompanies the *Third Side* series. Assume that a program has been written which reads in three integers and checks whether they represent the sides of a triangle, producing a suitable error message if they are not. If they do, then the program classifies them as being either equilateral (all sides equal), isosceles (two sides equal) or scalene (no sides equal).

The behaviour of the program can be characterised in terms of its test data - see Figure 3. Each area represents test data which exercises the program the same way. For example, the area marked *Equilateral* contains triangle data which will be classified as being equilateral.

Most programmers will generate test data which lies at the centre of one of these areas. However, the most effective test data is generated near to the boundaries, or at the boundaries. Such test data will normally discover common errors such as a loop being executed one time too many or too few, or a < less than operator being used instead of a <= less than or equal to operator. That is why the test data *4,3,3*, which tests for an isosceles triangle, is much more revealing than the test data *17,17,5* - it lies much nearer to the boundary of two areas.

It's surprising how many errors are detected by a programmer explaining his own program

The best mix

To sum up, the best way to generate high quality test data is to use decision tables to generate an initial test set, then use error guessing and equivalence partitioning in order to supplement this with data which is almost guaranteed to blow up the software under test.

It is worth stressing that the mix of data that is generated really depends on the problem. Some systems are heavily decision-based and a large amount of decision-table data should be generated. Other systems will generate a small amount of decision-table data and a lot of error-guessing data.

As a final example, consider the testing of a module

```
FIND(a,n,x,t)
```

which sets the variable `t` to one if the integer `x` is contained in the first `n` locations of the integer array `a`, otherwise clears it to 0. The maximum size of the array is 100 elements. The test data that I would generate for this problem is shown in Figure 4.

Note that error guessing data, such as character strings for numeric input, would not be used in this case as it is a test of a module. Instead they would be used if a whole system was being tested, especially one which required considerable interaction with the user.

And if all this generation of tables and study of results seems like too much bother, you know what to do. Go out and hire a psychotic.

EXE

Darrell Ince is a Professor of Computing Science at the Open University. Until recently, he was acting head of the computing department.

At their breaking point

Dan O'Brien and some source debuggers examine each other's mistakes.

Debuggers are the big comfy chairs of programming. You buy one early on and use it all the time. Gradually, you become accustomed to its bumps and patches. Later in life, you find it impossible to get out of. Finally, it falls over, and you have to get a new one. A lot of PC debuggers, I suspect, have been falling over in the past year. Standards have changed: OOP's got its foot in, DOS extenders are two-a-penny and 386 coding is all the rage. Is it time to junk SYMDEB and move on?

The debuggers we have reviewed here work as stand-alone debuggers, and are sold as such. We decided early on to exclude programs only available as part of a high-level language package, or designed to support only one range of products. This missed some important contenders - the Zortech and TopSpeed debuggers are, despite their omission, perfectly worthy programs. No-one, however, is going to switch languages solely on a debugging recommendation. That said, we did include Soft-ICE's Bounds-Checker, a program some would deny status as a debugger at all. We felt, however, that it addressed in a novel way many problems that usually throw programmers into the arms of debuggers. We also excluded the big boys: the In-Circuit Emulators such as the Periscope IV. Impressive as they are, they are pricey and bear a sledgehammer/nut-like relationship to most DOS applications.

This left us with five products to pick over: Nu-Mega Technologies' Bounds-Checker and Soft-ICE, Microsoft's CodeView, Periscope I, and the Borland Turbo Debugger. All except Bounds-Checker have been around for some time, although all the companies have released new versions of their software in the last few weeks.

Fans of *Which?* magazine will recognise the 'more blobs the better' format of Figure 1. Following the Consumer Association further, we decided to test each debugger to destruction. After all, one expectation of a debugger is that it shouldn't crash, even in the face of massive programming incompetence. So we set up each debugger to 'debug' the following uranium-laced suite: two programs that walked over the segment 0 interrupt vector table (one forwards, one backwards), two bug-ridden keyboard interrupt TSRs, and one grimly determined infinite loop with all interrupts disabled and the NMI port constantly being accessed. Results of these tests, and other technical information, are stored in Figure 1's packed array.

1991 will be an interesting time, as the Chinese curse has it

CodeView V3.10

We begin with the old boy. Microsoft CodeView, on its first release in 1986, set the standard for source code debuggers. It allowed simultaneous viewing of both low-level and high-level code, monitoring of variable changes, and simple to use trace and breakpoint features. It's gone through changes since then, but the commands, basic features and the familiar split-level (variables, source, command lines) display have remained constant.

Sadly, CodeView has suffered what the old American journals used to describe as 'bit decay': the strange affliction of code that turns fine software into an untidy morass within a few updates. This, together with what might be termed Spoilt Development Team Syndrome, has meant that CodeView can now only realistically be run on a *damn* fast processor with a lot of spare RAM, disk space and, preferably, a second monitor (obligatory in CodeView for Windows). And even then it's a monster, as anyone who has found themselves raising small families during a CV reload will testify.

Nevertheless, CodeView still scores well at being a source-code debugger, in the strictest sense. If you dive no lower into PC arcana than using the occasional 'far' with your pointer definitions, CodeView will help (probably more than Soft-ICE and Periscope, which assume a fair degree of 80x86 savvy). Unfortunately, DOS bugs generally lie a level lower than that, in illegal pointer addressing and segment nightmares. Out of all the debuggers, CodeView crashed the most when faced with deeply errant code. This is forgivable, if one remembers that looking after interrupt vectors and TSR debugging isn't what CodeView was written for. CodeView was written to debug payroll packages, and sneer as much as you wish, it does that well.

CodeView also has the considerable advantage of being Microsoft and, therefore, court favourite. This provides several benefits. Other debuggers emulate it, so if you know how to use CodeView (despite window dressing, it's a command line beast), you'll know how to use any other debugger. If something happens in the Microsoft/Intel/IBM sphere, CodeView will be the debugger that will handle it first. And it's still the only Windows Enhanced source-code debugger.

Is it worth getting CodeView? Bought with MASM 5.0 in the stand-alone package, probably not: the two don't compliment each other very well. If you're using a Microsoft language, you should have it already. If you have it and use it, and hate it, then don't worry: there are better packages.

Soft-ICE V2.5

Soft-ICE will be a familiar product to regular readers: .EXE has reviewed it twice in the past. It's a 386 debugger that runs programs in a virtual 8086 box, allowing trickery usually associated with In-Circuit Emulators (hence the name). This includes breaking out of code with interrupts disabled, and the provision of sophisticated breakpoint facilities, including full speed breakpoints on memory read, and large (up to 4 GB) breakpoint ranges - useful for write protecting blocks of memory.

Virtual debugging is an exceptionally good way of isolating a debugger from madly thrashing code: unfortunately, it also means you can only debug real mode software. A possibly greater restriction is that you can't use it with other virtual handlers present - ruling out the use of Qualitas' 386MAX, QEMM or, for that matter, enhanced mode Windows 3.

Soft-ICE softens the blow by including a full (LIM 4.0) expanded memory manager in its kernel, and by allowing the loading of TSRs and device drivers into high memory. It is also vindicated by being an extremely good virtual debugger. Its emulation of a standard real mode system is excellent: even our other debuggers thought they were running under real mode. Intel's undocumented LOADALL function (see .EXE's passim) is fully emulated, as are the BIOS extended memory move operations. The new instructions of the 386 and 486 are fully supported.

Soft-ICE also won prizes for sheer resilience. Soft-ICE stood fast throughout the .EXE lunatic code, returning its prompt at all times. In fact, the only way we could get it to crash was by sneakily switching to protected mode - a move which Soft-ICE, fair enough, took great exception to. Overall, this compared very favourably indeed with our other debuggers, which failed at least one test (see table).

Soft-ICE principle drawback is that, like SYMDEB, it is primarily a machine-code debugger with source code extensions. It is also a little unfriendly, using DEBUG-style one letter commands, albeit with a status-line help. SYMDEB hackers will be mightily impressed, but CodeView users can expect to be disappointed with its lack of decent variable inspection features. Soft-ICE knows nothing of structures and you would certainly be hard pushed to follow a linked list using its simple memory dump. You *can* use CodeView and Soft-ICE together, but the twinned operation is convoluted and I shudder to think of the memory usage, even if you do shove it all up into your extended RAM.

Soft-ICE, when it was first released, had no real competition. Its price of $386 was a bargain. Now other debuggers are beginning to appear with the same features, Soft-ICE is losing its pre-eminence. Moreover, all Soft-ICE's advantages reflect its authors' in-depth knowledge of virtual machine mechanics: a protected mode version of Soft-ICE would have to be an entirely different beast to compete. Soft-ICE knows its limitations, and it is good at what it does: if you are developing standard DOS applications, and will do so for the foreseeable future, it's probably the toughest of the pack. If you're looking to move up to the fertile plains of protected mode operation, Soft-ICE will be just a pricey addition to your doorstop collection.

The simplicity of the concept belies Bound-Checker's usefulness

Bounds-Checker V1.0

Along with our review copy of Soft-ICE came Bounds-Checker, Nu-Mega's new product. Bounds-Checker is not a debugger *per se*. Rather, Nu-Mega has used virtual debugger techniques to implement what is, in effect, an automated bug-finder. It works by closing off all of a 386 system's memory from your program, except for those areas which are explicitly decreed to be modifiable. This will usually be the program's data segments, but it could also be display memory, or unallocated RAM. Your program is then run under Bounds-Checker via a small stub loader. Now, any writes to (or reads from) outside these rigidly defined zones will be signalled, and the source code in which they occur can be noted in a file, or added to the exception list. Moreover, if there are any other rogue TSRs attacking your code, their illegal accesses can be tracked as well.

The simplicity of the concept belies Bounds-Checker's usefulness. I found Bounds-Checker to be an immensely handy program. Apart from discovering faults that would otherwise go entirely unheeded, it was useful as a prelude to debugging, as it pin-pointed quickly where in the code matters were beginning to go wrong. Naturally, it spotted our interrupt vector bruisers before they began. It also prevented the buggy TSRs from doing any damage, and was instrumental in tracking down a couple of real live bugs which had been plaguing the .EXE office for some months (pride prevents us from revealing exactly how long).

This is a program that is easy to understand, easy to use (the Bounds-Checker logging system could be used by anyone, and a large section of the documentation explains exactly how one can delegate bug detection using the program) and, more important, productive. Being based on the same technology means that it suffers the same implementation restrictions as Soft-ICE, but as most of the bugs that Bounds-Checker could trap would be caught by a decent protected mode memory handler anyway, this is less of a restriction. A good implementation of an idea that has come not a moment too soon.

Periscope I, Rev 3 V5.0

Periscope has a long history, as can be guessed by the number of version tags it sports. The early Periscope years were based on one product, a PC card pulled the NMI line low and kicked in Periscope's own source code monitor with one squeeze of a hand-held, rather Ian McCaskillish, breakout switch. This card's design has now reached its third revision, and now boasts 512 KB (expandable to 1 MB) of on-board memory for storing source and symbol information. The Periscope Company also produce a full ICE system, the Periscope IV, which plugs into the CPU socket and an ISA slot, and the Periscope II, a software version of Periscope I (with optional switch tied straight to the NMI line).

Periscope I's great advantage is that it can work on any system, from the humblest XT up. The card adapts, ingeniously, to an eight or 16-bit slot, and the software will work with all its clever bits on any processor. I had no problems, for example, in running the system on an old Compaq 286; not the most traditional of PC set-ups. All this means that it is ideal for on-the-fly (and in-the-field) compatibility problems. Its hardware roots also mean that it is a fine choice for ISA cards and DMA development. The many commendations we received on CIX for the Periscope system came from hardware developers who found it the only debugger they could use.

The Periscope I software resides in the fag end of the first megabyte, past 640 KB. The

software itself smacked of slapdash programming. A pull-down menu system and built-in help failed to hide an old and unfriendly front-end. As expected from an NMI-driven debugger, it toughed out a number of tricky situations, as our tests show, but in general use had a tendency to crash without obvious reason. Extra features like 386 debugging support, key redefinitions, and data structure inspection seemed like awkward bolt-ons, although Windows real mode support was good (and unique out of the debuggers reviewed). My overall impression was of well-designed hardware let down by software support. The Periscope program also shows a touch of Spoilt Developers Syndrome itself, with most of my discovered bugs coming under the category of 'that wouldn't happen if you were using a Periscope IV with Secondary Monitor'.

In fact, the Periscope I is treated throughout the documentation and software as the little brother of Periscope IV. Some features, for example, that wouldn't be impossible to emulate in software on a 386 hosted Periscope I (like pass counters and selective capture for tracing) have ended up on Periscope IV only. Given that other debuggers manage some of these tricks and don't cost as much as Periscope I, let alone Periscope IV's £1000+ price tag, this does seem a smidgeon foolish. On the other hand, Periscope have been excellent at updating and modernising their systems in the past, and a plethora of 'Real'Soon Nows' in the documentation may mean that Periscope I's paucity won't last long. Certainly, the Periscope system doesn't face the protected mode ceiling of a program like Soft-ICE. I'm just not sure, given the current evidence and the temptations of their full ICE system, how much attention Periscope will give to its first born.

Name:	CV	SI	BC	TD	PE
Version	3.10	2.5	1.00	2.01	5.0
Price	£99	$386	$249	£105	£355
Processors: (8086, 286, 386, 486)	0234	34	34	0234	0234
Hardware/Software/Virtual	Soft	Virt	Virt	S&V	Hard
Interface					
WIMP?	Part	No	No	Yes	Part
Mouse support?	Yes	No	No	Yes	No
Ease of Use	●	●●●	●●●●	●●●●	●●
Disc use?	Lots	None	Small	Small	None
Documentation	●●●	●●●●	●●●●	●●●●	●●●
Redefinable function-keys?	No	Yes	No	No	Yes
Secondary monitor?	Yes	Yes	Yes	Yes	Yes
Dumb terminal?	No	Yes	No	No	No
Alternative PC?[2]	Yes	No	No	Yes	Yes
Features					
Source breakpoints	Yes	Yes	-	Yes	Yes
Assembler breakpoints[1]	Yes	xrw	-	xrw	XRW
Breakpoint ranges	No	Yes	Yes	Yes [6]	Yes
Variable inspection	●●●●	●●	-	●●●●●	●●●
Stack inspection	●●●	●●	-	●●●	●
Backtracing	●●	●●●	-	●●●	●●
Debugging EMM programs	●●	●●●	-	●●●	●●●●
Debugging TSRs/Device drivers	●	●●●●	-	●	●●●
CLI loop test?	No	Yes	-	Yes[6]	Yes
Interrupt vector destruction test?	●●	●●●●●	-	●	●●
Extended memory use	Can	Can	Can	Can	Can
Expanded memory use	Can	Can	Can	Can	Can
Compatibility					
Linker support: (MS,TLINK,RTLINK,PLINK)	M	M,T,R	M,T,R	M,T	M,T,R,P
Can work with: (CodeView,SoftIce,Periscope,Turbo)	S,P	C,P,T	S	S,P	C,S,T
Can pick debug information from .MAP?	No	Yes	Yes	No	Yes
Easy to move from: (CodeView, Turbo, SYMDEB)	S	S,T,C	-	C	S,C,T
Object oriented browser?	G[3]	No	-	T	No
Name unmangling? Zortech,Glock,Turbo	ZG[4]	ZG[4]	-	ZG[4]T	ZG[4]
The Future[7]					
OS/2?	Yes	No	-	?	Yes
Protected?	Yes	No	-	RSN	RSN
Windows?	Yes	?	-	RSN	Yes[5]

[1]
xrw - Execute-only, Read-only and Write-only breakpoints on 386.
XRW - Execute-only, Read-only and Write-only breakpoints on all machines.
[2] Alternative PCs have a full screen display; dumb terminal support is just an ASCII serial link.
[3] With Glockenspiel PWB support package.
[4] With Cfront name unmangler.
[5] Real mode ONLY.
[6] TD386 only.
[7] RSN = Real Soon Now.

Turbo Debugger V2.01

Turbo Debugger is Borland's house replacement for CodeView. It did not begin its tour of duty at .EXE well. For one thing, Turbo Debugger has a fully WIMPed interface, with overlapping windows and all that. Now, if there is one area (screams the Luddite in me) where command lines still have a rôle, it's in a debugger. First, because command line histories do, at least, give an easily stored record of the debugging session, which is something that 'state of the machine' windows and mouse-based commands cannot easily achieve. And second, after three months of typing up code, most people aren't afraid to do a little 40 wpm in order to throw up a hex dump. Mousing through a desk full of empty coffee cups is an irritation, not an aid to accessibility.

I suspended judgement and moved onto our crash and burn tests. On my first run of the Interrupt Vector Stomper, I had to stop and re-check my code. Surely Turbo couldn't have crashed *that* soon? Somehow, it had managed to snarl itself on a corruption of interrupt vector 0xFC, just four vectors into the test. Even CodeView can handle corruptions down to INT 0x6D. A closer look at the code, and much later Turbo Debugger's manual revealed the problem: Turbo Debugger only preserves interrupts from 0x2F down, on the assumption that this will be 'okay'. And so it will, unless (for example) you run KEYBUK.COM, the old DOS 2 English keyboard handler, a TSR which re-calls itself through higher (INT 0xFC) interrupt vectors. In fact, Turbo Debugger wasn't very good on interrupt based TSRs at all, crashing under all those I tried to debug. A shame, particularly as tracing through TSRs is exactly what people want stand-alone debuggers for.

Further confirmation of my pessimism came when I tried programs created on non-Borland compilers. The Turbo range possess their own debug format, which Turbo Debugger naturally supports, so CodeView-compatible .EXE files have to be converted using a small, supplied utility. Alas, TDCONVRT.COM is not much cop: it's slow, and doesn't always work. It misunderstands comment records, for instance, which makes it fail on many Zortech compiled programs.

Despite all these problems, Turbo Debugger did, in the end, win me over. The reason for this is a feature not greatly documented by Borland - one chapter in the

SWISS QUALITY, AMERICAN SUPPORT. IN THE U.K. AT UNBEATABLE PRICES.

PRE-SALE CONSULTING

POST SALE SUPPORT

* Serving Europe since 1987 with latest tools for programmers.
* Authoritative solutions to the most complex applications.
* Technical Support.
* Guaranteed latest versions.
* Over 3,000 titles. - Call for Price List-disk.

ARTIFICIAL INTELLIGENCE:
Arity Combination Pack v5.1 £ 660
PDC Prolog DOS v3.2 £ 190
PROLOG-2 Personal £ 90
Turbo Prolog 2.0 £ 60

ASSEMBLERS, LINKERS & DISASSEMBLERS:
Microsoft Assembler v5.1 £ 88
Plink86Plus £ 300
.RT-Link v4.0 £ 300
Sourcer v3.0 with Bios Pre-Processor £ 95

BACKUP:
Back-It £ 56
Copy II PC v5.0 £ 25
Central Point Backup £ 57
FastBack Plus £ 103
Norton Backup £ 89

BASIC:
HyperHelp £ 82
Microsoft BASIC v7.1 £ 265
Microsoft Quick BASIC v4.5 £ 55
PowerBASIC v2.1 £ 59
ProBas £ 130

BUSINESS
FormFiller v3.0 £ 78
FormTool Gold v3.0 £ 53
Grammatik IV £ 47
GrandView v2.0 £ 180
GRASP w/Art Tools v3.5 £ 104
Lotus 1-2-3 v3.1 £ 388
Lotus Agenda v2.0 £ 240
Microsoft Office for Windows £ 580
ORG Plus Advanced v5.0 £ 63
Quattro Pro £ 277
SCO Lyrix 386 v6.0 £ 351
SQZ! Plus £ 63
Super Project Expert £ 394
TimeLine v4.0 £ 411
WordPerfect v5.1 £ 240

C:
C ASYNCH MANAGER v3.0 £ 116
C Utility Library v4.0 £ 142
C-terp w/Source v3.3 £ 155
c-tree £ 219
Clear + for C £ 115
Control Pak/Windows £ 360
dANALYST v4.0 £ 185
Essential Communications v3.0 £ 169
Greenleaf Communications £ 236
Greenleaf Functions Library v4.0 £ 124
Lattice C Compiler v6.0 £ 143
Microsoft C Compiler v6.0 £ 239
Microsoft Quick C/Quick Asm. v2.51 £ 99
PC-Lint £ 73
Pro-C with Workbench £ 262
r-tree £ 159
Turbo C Tools v6.02 £ 92

CADD:
3-D Draftting £ 172
AutoCAD Release 10 £2277
AutoSketch v3.0 £ 125
Design CAD 3D v3.0 £ 183

CASE:
CASE for Windows £ 839
CASE PM for C £1679
CASE PM for C++ £1679
Compeditor II £ 213
EasyCASE Plus £ 239
Teamwork/PCSA £ 898

COBOL:
COBOL-85 v4.1 £ 707
COBOL spII £ 389
LPI COBOL £ 900
Microsoft COBOL v3.0 £ 520
RM/COBOL-85 Development System £ 706

COMMUNICATIONS:
Carbon Copy Plus + Host £ 103
CO/Sessions Complete £ 152
Crosstalk Xvi v3.71 £ 102
LapLink III £ 78
Mirror III £ 48
pcAnywhere III £ 71
Procomm Plus v1.1b £ 63
Remote2 Complete £ 102
Smartcomm III £ 127
SmarTerm 240 v3 £ 178
Takeover £ 153

DATABASE & FILE MANAGEMENT:
4GL Rapid Dvlp System w/Debugger £ 569
ALPHA Four v1.1 £ 281
AskSam £ 153
Btrieve £ 142
Clarion Professional Developer v2.1 £ 430
Clipper v5.0 £ 470
Codebase 4 v4.2 £ 209
dB_FILE & dB_Retrieve w/Object Srce £ 209
dBC III Plus £ 315
dBASE IV v1.1 £ 438
dbFast/Plus v1.4 £ 141
dbFast/Windows 2.0 £ 142
DBXL Diamond v1.3 £ 129
FoxBASE+/386 £ 271
FoxPro £ 424
Novell XQL £ 449
Paradox 3.0 Competitive Upgrade £ 133
Paradox v3.5 £ 463
Professional Oracle Developers Kit £ 609
R&R Clipper/Foxbase+ Module £ 33
R&R Report Writer for XDB SQL £ 182
R:BASE v3.0 £ 428

DEBUGGERS:
Multiscope Windows/DOS Debugger £ 279
Periscope I v4.1 £ 357
Periscope IV 16Mhz £1229
Periscope IV 25Mhz £1599

DESKTOP PUBLISHING:
Aldus PageMaker v4.0 £ 462
Aldus Persuasion v2.0 £ 294
Freedom of the Press £ 225
GoScript v3.0 £ 86
Halo DPE £ 112
HiJaak v2.0 £ 122
Micrografx Designer 3.01 £ 434
Omnipage 386 v2.1 £ 547
ProScan w/Picture Publisher & Words £ 846
Publish It! £ 104
Ventura Publisher Gold Series v3.0 £ 500

DISK/DOS UTILITIES:
Lotus Magellan v2.0 £ 94
MACE Utilities 1990 £ 86
Norton Utilities v5.0 £ 89
OPTune £ 43
PC Tools Deluxe v6.0 £ 79
Q-DOS II £ 35
System Sleuth v2.1 £ 70
Windows DOS £ 39
Xtree Pro Gold £ 75

EDITORS:
Brief v3.0 £ 136
Sage Professional Editor £ 180
VEDIT PLUS v3.3 £ 95

FORTRAN:
Lahey F77L-EM/32 v3.0 £ 629
Fortran Toolkit 1 v5.2 £ 67
Fortran Toolkit 2 v5.2 £ 110
GRAFMATIC & PLOTMATIC £ 147
Microsoft FORTRAN v5.0 £ 239
RM/FORTRAN v2.44 £ 338

GRAPHICS:
Corel Draw v1.2 £ 304
Essential Graphics v3.0 £ 199
Graph-in-the-Box Executive £ 154
GSS Graphics Development Toolkit £ 329
HALO v3.x £ 214
Harvard Graphics v2.3 £ 321
MetaWINDOW/PLUS £ 169
STATGRAPHICS £ 507

HARDWARE:
386 HummingBoard 12MB/20MHz £1860
ASCII 2400 Internal Modem £ 74
ASCII SuperVGA 1024X768 w/512K £ 127
Excell Laptop 386SX-16. With 4Mb RAM, 100 Mb Hard, VGA £2000
Echo II Speech Synthesizer (PC XT/AT) £ 112
Logical Connection Plus £ 513

INTEGRATED:
Framework III £ 398
Lotus Works £ 84
Microsoft Works v2.0 £ 88
Q&A 3.0 £ 202
Symphony Plus v2.0 £ 420

LAN & LAN-READY SOFTWARE:
Btrieve/N v5.01 £ 344
FoxPro Multiuser £ 583
Framework III (5 Users) £ 568
LANtastic Ethernet Adapter £ 227
LANtastic Ethernet Starter Kit £ 469
Networker Plus £ 134
Novell ELS I Netware v2.12 £ 426
Novell ELS II Netware v2.15c £ 998
Novell: Entire product line CALL!
Paradox Network Pack v3.0 £ 557
Q-DOS II (8 User) £ 100
R:BASE for DOS £ 431
Saber LAN Administration Pack v1.1 £ 328
Saber Menu for Windoes v3.0 £ 234
Ventura Publisher Add'l Node £ 266
WordPerfect Add'l Station £ 153
XtreeNet ELS Level 1 & 2 £ 129

MACINTOSH:
Adobe Type Manager v2.0 £ 55
Carbon Copy Mac £ 106
Claris CAD v2.0 £ 543
Color Studio £ 553
Copy II Mac £ 25
DiskFit £ 50
FastBack Mac II v2.1 £ 108
FoxBASE+ V2.01 £ 270
Freedom of the Press v3.0 £ 225
FullWrite Professional £ 178
Generic Cadd Level 1 v1.1 £ 75
LapLink MAC £ 105
MacPaint v2.0 £ 78
MacSleuth £ 70
MacTools Deluxe v1.0 £ 74
Mathematica for Mac II v1.2 £ 639
Microsoft Write £ 76
Norton Utilities £ 77
OmniPage £ 485
PageMaker v4.0 £ 472
Publish It! Easy £ 104
Smalltalk/V v2.0 £ 59
SUM II £ 93
SuperCard v1.5 £ 174
Think C £ 152
Think Tank v2.41 £ 120
Turbo Pascal £ 63

MEMORY MANAGEMENT:
386 Max Professional £ 68
Above Disk v4.0 £ 56
DESQview 386 w/QEMM v5.1 £ 115
QEMM/386 v5.1 £ 54
QRAM with Manifest £ 43
Turbo EMS £ 48
VM/386 Multitasking £ 127

MODULA-2:
EmsStorage with Full Source £ 47
Logitech Modula-2 Dvlpt Sys £ 151
Topspeed Modula-2 OS/2 Compiler Kit £ 349

OBJECT ORIENTED PROGRAMMING:
Actor v3.0 with Language Extensions £ 500
Matrix Layout v2.0 £ 116
Smalltalk/V 286 £ 115
Turbo C++ Competitive Upgrade £ 133
Turbo C++ Professional £ 183
Zortech C++ Compiler v2.1 £ 109
Zortech C++ Developer's Edition £ 259

OPERATING ENVIRONMENTS:
Concurrent DOS 386 v3.0 £ 250
DR DOS 5.0 £ 126
IBM OS/2 Extended Edition v1.2 £ 559
Interactive UNIX 386/ix Op Sys £ 300
Microport Sys V Rel. 4 Comp. Limited CALL
Microport Sys V Rel 4 Comp Unlimited CALL
Microport Sys V/286 Rel. 2.4 Comp. Limited CALL
Microport Sys V/286 Rel. 2.4 Runtime Limited CALL
Microsoft Windows v3.0 £ 89
SCO Open Desktop £ 749
SCO UNIX 386 Dvlpt System v3.2 £ 585

OS/2 PRODUCTS:
Brief Editor £ 136
Btrieve £ 349
Control Pak/PM £ 360
Describe Word Publisher £ 372
Excel-PM £ 285
GSS Graphics Devel. Toolkit £ 329
IBM DisplayWrite 5/2 £ 222
Lotus 1-2-3/G £ 457
Multiscope Debugger v1.2 £ 272
OS/2 Presentation Mgr. Toolkit £ 290
Paradox £ 440
PDC Prolog OS/2 v3.2 £ 452
Poly AWK £ 122
R:BASE £ 550
SideKick PM £ 118
Smalltalk/V PM £ 283

OTHER LANGUAGES, TOOLS & MISC.:
Adobe PostScript Cartridge £ 267
LaserGo 1Mb Board w/GoSelect £ 156
MS Mouse With Windows v3.0 £ 139
Niscan Grey Scale Hand Scanner £ 186
PolyMake £ 92
RPG II Development System v3.0 £1123
ScanMan Scanner £ 165
Slate - Universal Printer Driver £ 189

PASCAL:
B-Tree Filer £ 78
Borland Developers Library v4.0 £ 241
Microsoft Pascal v4.0 £ 165
Pascal TOOLS & TOOLS 2 £ 108
POWER SCREEN £ 92
Turbo Analyst £ 62
Turbo Pascal v6.0 £ 89
Turbo Pascal Pro. Second Edition £ 145
Turbo Pascal v5.5 £ 119
Turbo Professional £ 79

SCIENCE & ENGINEERING:
Derive v1.6 £ 139
Eureka: The Solver £ 103
MathCAD v2.5 £ 287
Mathematica/386 v1.2 £ 559
Mathematicia for Windows £ 799
SSP/PC Scientific Subroutine Library £ 230

SCREEN DESIGN & WINDOWING:
Flash-Up Developer's Toolbox £ 51
Greenleaf DataWindows w/Source £ 175
PANEL Plus II £ 253
Vermont Views v2.0 £ 239

TRANSLATORS:
BAS_C Commercial £ 228
BAS_PAS Commercial £ 171
dBx/dBport v.4.7 £ 453
FOR_C w/Binary Runtime £ 348

UNIX/XENIX PRODUCTS:
4GL Rapid Develop. Sys. w/ Debugger £1216
FORTRAN Compiler for XENIX/386 £ 409
Interactive 386/ix Software Dev. Sys. £ 435
Norton Utilities for System V £ 195
Pascal Compiler for XENIX/286 £ 409
Prof. Oracle SCO Unix/Xenix 386 £1378
Quicksilver/UNIX 386 £ 500
RM/COBOL-85 for UNIX/XENIX 386 £1072
SCO Portfolio Suite 386 £ 935
VEDIT PLUS for Unix/Xenix £ 174

WINDOWS 3.0 APPLICATIONS:
Adobe Illustrator v1.1 £ 270
Adobe Type Manager £ 56
Asymetrix Tool Book £ 270
Charisma v2.0 £ 310
Crosstalk for Windows £ 113
DRAFIX/Windows CAD v1.1 £ 393
Facelift for Windows £ 58
Form Publisher £ 129
FormBase £ 283
Guide 3 for PC £ 335
JetForm Design £ 254
Microsoft Excel v2.1x £ 279
Microsoft Powerpoint for Windows £ 287
Microsoft Project for Windows £ 401
Microsoft Windows SDK v3.0 £ 289
Microsoft Word for Windows v1.0 £ 287
PER: Form Pro £ 254
SQLWindows v1.3 £ 798
Superbase 4 Windows £ 355
Windows 3 Device Drvr. Dvlpmt. Kit. £ 307
Wingz for Windows & OS/2 PM £ 295
WinSleuth v2.1 £ 70

* Prices exclude V.A.T. but include first class recorded delivery
* Thirty day billing for qualified organizations.
* All major credit cards accepted.
* C.O.D. orders OK.
* Prices subject to change without notice. E12/90

USA SOFTWARE

16 CONNAUGHT STREET • LONDON, W2 2AG, U.K.
PHONE: 071-402 0722 FAX: 071-724 9847

Over 3,000 products carried. Call today for price list-disk.

CIRCLE NO. 384

back of the manual. This is a 386 version of Turbo Debugger included on the disk that reveals itself, on closer inspection, to be a full virtual mode debugger.

TD386 as it is, stands above all the other debuggers reviewed. In CodeView, 386 enhancements are practically non-existent. Soft-ICE does it all well, but falls down on source support and ease of use. Periscope can do 386ish things on other processors, but skimps using the proper on-chip facilities when running on a 386 system. Turbo Debugger, on the other hand, implements it all, and well. The 386 usage is entirely invisible to anyone used to Turbo Debugger: except that suddenly they can write-protect 100 KB of memory, or watch variables while running at full speed, or watch for pokes into code.

Together with Turbo's excellent implementation of what CodeView fouls up (good variable inspection and excellent backtracking), its low-level code support, its built-in OOP class browser, and (on 286/386 systems) its high-loading facility, Turbo Debugger comes closest in our selection to what one should *expect* a modern debugger to do. Nevertheless, while the bugs we found weren't ruinous, they did shake one's faith in the product as a whole.

Conclusions

There's a great deal of competition in the debugging market, and these five products cover a lot of ground. If you want, you should be able to pick one that will satisfy your requirements. If your debugging life consists mainly of COBOL-like manoeuvres, CodeView is probably the best bet. If you want a safe, reliable debugger for TSR and other low-level DOS work, Soft-ICE seems a better choice. Periscope I lends itself to work that requires testing on a number of systems, or if you are debugging hardware developments. Turbo Debugger is an excellent debugger for Borland products, although given its problems I'm somewhat reluctant to recommend it whole-heartedly for general use. Bounds-Checker will, I imagine, generate its own market: I would most definitely recommend it for use on products meant for general PC consumption.

My difficulty lies in foreseeing a long lifespan for these products. 1991 is going to be a very interesting time, as the Chinese curse goes, for PC software developers, and the fact that none of these debuggers (apart from the behemoth CodeView) support Windows 3 enhanced must be seen as a severe limitation. Several companies, including Zortech and Multiscope, are due to release protected mode debuggers within the couple of months. Out of the five products, I would say only Bounds-Checker and possibly Turbo Debugger have adapted to the changes in the last year or so; the remainder are rather resting on their laurels. The competition, as I've said, is already high in the debugger market: expect it to get a lot worse, soon. If you're not desperate for a new debugger right now, I'd stick with SYMDEB a little while longer, and wait for the New Year sales.

EXE

Prices for CodeView and Turbo Debugger were taken from Grey Matter's price list. Soft-ICE and Bounds-Checker are available direct from Nu-Mega Technologies, PO Box 7607, Nashua, NH 03060-707, USA. (Tel: 0101 603 888 2465). The Periscope range is available from Roundhill Systems, at Orchard House, Ogbourne St George, Marlborough, Wiltshire SN8 1SU.

Transform your PC into a colour X terminal

With X software from Unipalm, your networked PC becomes a fully functional colour X terminal.

For workstation-style performance, run X windows native on DOS - or integrate X sessions with DOS applications under ***Microsoft Windows 3.***

Fully compatible with ***Motif*** *and* ***Open Look,*** *your PC will open windows onto multiple hosts and applications, regardless of operating systems. You can cut and paste between each window, whatever and wherever the application.*

X software from Unipalm is compatible with EGA, VGA and many high-resolution video cards. Network support for Token Ring and Ethernet is available using standard TCP/IP and NFS protocols.

Unipalm

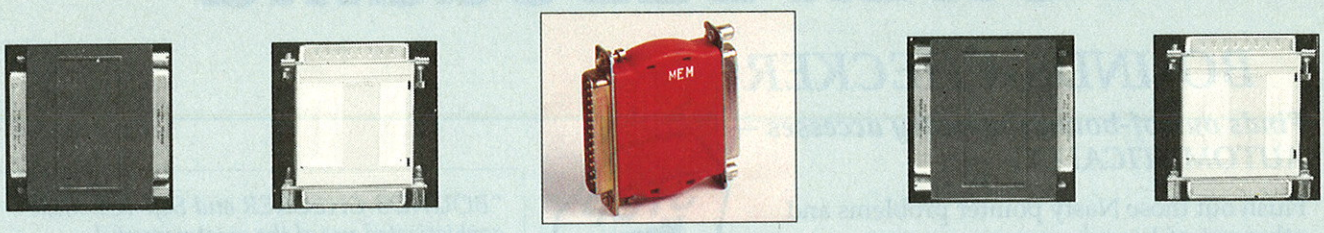
All trademarks recognised.

Unipalm Limited 145-147 St Neots Road • Hardwick • Cambridge CB3 7QJ • England
• Tel 0954 211797 • Fax 0954 211244 • Intl. Tel +44 954 211797 • Intl. Fax +44 954 211244

CIRCLE NO. 385

SOFTWARE PROTECTION!

Can You Spot The Difference?

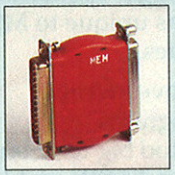


- ☑ High-level security keys
- ☑ Assembler-based, customer specific, encrypted interrogation routines
- ☑ Over 70 languages supported
- ☑ Compatibility - due to 8 years experience & 600,000+ keys sold
- ☑ Reliable on-going support
- ☑ Physically unique keys for each customer
- ☑ MS-DOS, OS/2, UNIX, XENIX, WINDOWS 2 & 3, "MACINTOSH"
- ☑ Transparent operation with most peripherals on market
- ☑ Free language updates
- ☑ Parallel, Serial, Mac ports

OVER 3,100 CUSTOMERS WORLDWIDE HAVE!

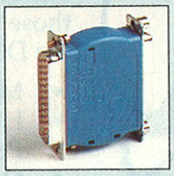
Electronic Key

The ideal device for identically produced software packages. Uniquely wired with customer code and a software code. Uses Assembler based program, decryption interface and random values.



1 Word Memory Key

Custom hardware wiring allows the developer total control over information stored in the key. 2 bytes of memory allows several packages to be protected with just the one key.

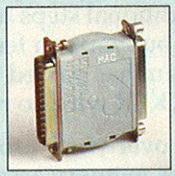


31 Word Memory Key

For multiple software protection schemes. 31 words of 16 bits of non-volatile dynamically programmable memory. Its capacity to store information provides virtually limitless power. Flexible protection scheme can be modified on-site during operation of software package.

Micro Processor Key

Provides the ultimate in software security. Not tied to any language or O/S. 8 bit microprocessor powers from RS-232 level. Requires no power supply. For PC terminals, minis, & others using RS 232 C comms. Used on workstations. This key is effectively a computer.



Macintosh Key

Extremely powerful & customised protection for the Mac. 31 words available for random storage. Providing unequalled protection the Macintosh Memory Key connects to the SCSI 25 pin port and operates transparently.

MICROPHAR... The European Standard!

For a no-nonsense informative discussion on how our dongles can better protect your profits, please call us on:

091-378 9191

CLEARSOFT

CLEARSOFT, Littleburn Ind. Estate,
Langley Moor, Durham DH7 8HG.
Telephone: (091) 378 9191 Fax: (091) 3789393

Please send me full details on your protection systems.

Name: .....

Position: .....

Address: .....

.....

Telephone: .....

Fax: .....

Signature: .....

Clearsoft, Littleburn Ind Est,
Langley Moor, Durham, DH7 8HG
Tel: 091 3789191 Fax: 091 3789393

CIRCLE NO. 431

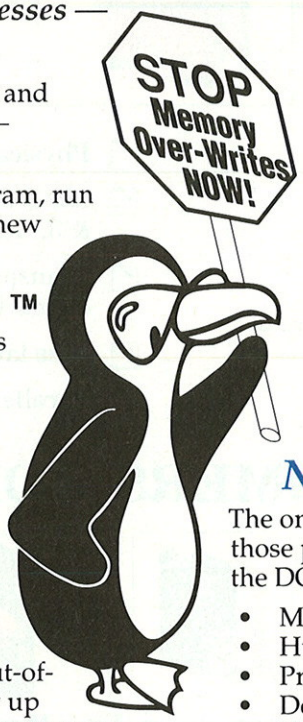
POWER DEBUGGING

BOUNDS-CHECKER

Finds out-of-bounds memory accesses — AUTOMATICALLY.

Flush out those Nasty pointer problems and other out-of-bounds memory accesses — AUTOMATICALLY.

Each time you make a change to a program, run BOUNDS-CHECKER while testing the new code. If you accidentally access out-of-bounds memory, BOUNDS-CHECKER will pop up displaying the offending SOURCE LINE. And your program runs at full speed.



"BOUNDS-CHECKER and Soft-ICE make sophisticated use of the most powerful versions of Intel's processor family to track down some of DOS programming's most insidious bugs. If you're developing programs for DOS, these are essential tools."

PC Magazine
July, 1990 pg. 48

Ship Bug-Free Products

You can run BOUNDS-CHECKER while testing your program. There are no additional steps to your testing cycle, but you can feel secure when the program has passed through BOUNDS-CHECKER with no reported problems.

Many over-write problems and other out-of-bounds memory accesses do NOT show up during normal testing. An out-of-bounds memory location may be modified, but that particular location doesn't happen to be important at the time. Once the program is in the field and a certain network is loaded or a certain T&SR or device driver is loaded, that memory location suddenly becomes very important... AND THE SYSTEM CRASHES.

You can prevent these problems by making BOUNDS-CHECKER a standard part of your testing procedure.

Gives you the protection of a protected operating system under MS-DOS.

BOUNDS-CHECKER uses the 386 virtual machine technology to provide real-time memory protection. In addition BOUNDS-CHECKER uses the symbolic information output by your compiler to differentiate CODE and DATA. When your program is running, BOUNDS-CHECKER protects the program's CODE and all memory outside your program.

Requires 386 PC.
MS-DOS is a trademark of Microsoft Corporation.
386 is a registered trademark of Intel Corp.

Soft-ICE 2.5
New Version, New Features

The only debugger specifically designed to solve those problems unique to MS-DOS that we call the DOS Nasties.

- Memory over-writes
- Hung programs
- Program too big to debug
- Debugging T&SRs and Loadable Drivers
- Multiple Symbol Tables
- Supports Microsoft C 6.0 & Turbo C++

Windows Developers

Run CODEVIEW for Windows on a Single Monitor

Nu-Mega has done it again!

CV/1™ $129

Call Today, Have it Tomorrow

BOUNDS-CHECKER	*$249*
Soft-ICE 2.5	*$386*
MagicCV 3.0	*$199*
CV/1™	*$129*

Special Offer...

Buy BC & S-ICE	*Save $100*
Buy S-ICE & MCV	*Save $86*
Buy all three	*Save $186*

30 Day Money-Back Guarantee

Nu-Mega TECHNOLOGIES INC

CALL TODAY 0101 603 888-2386 or FAX 0101 603 888-2465
P.O. BOX 7780 ■ NASHUA, NH ■ 03060-7780 ■ U.S.A.

CIRCLE NO. 432

Gathering program statistics with C++

Talk of OOP invokes the image of towering class hierarchies and teaming virtual methods. Yet there are some good straightforward applications, as Bryan Boreham explains.

The code presented in this article contains no inheritance and no dynamic binding, which is a bit unusual for a piece on object oriented programming. However, it does demonstrate one way in which C++ can help to improve and structure your programs using a few new language features, but without requiring you to dive straight in and rewrite everything as objects. Let me tell you how it all began...

Some time ago, I was in the process of optimising the data storage code for a large C++ project. The objects were all retrieved via standard SQL from a relational database, and so it was important to try to reduce the number of database accesses being performed. So, I declared variables to count how many operations (retrievals, updates, deletes etc) were done, and more counters to try to discover what areas these came from.

```
#include <string.h>


void isort(char **a, int n)
{
  char *p;
  int i, j;
  for (i = 0; i < n; i++)
    {
      p = a[i];
      for (j = i-1; j >= 0; j--)
       {
         if (strcmp (p, a[j]) > 0)
           break;
         a[j+1] = a[j];
       }
      a[j+1] = p;
    }
}
```

Figure 1 - C implementation of insertion-sort

Each time I added a new counter, I would have to define it in the database module, then declare it as `extern` in the main program, where I needed a `printf()` to output the counter's final value at the end of the program. The whole business started to look a bit naff, and I had to recompile two modules for each iteration (not as trivial as it sounds, with the amount of `#include` files our project used). I set out to solve the problem in a neater way by using C++'s ability to extend the language by creating new types with special properties.

The problem

Since the system that sparked this development is so large, it would take several issues of .EXE to print the listing, I shall take, as an example, a small insertion-sort routine that takes as arguments an array of zero-terminated character strings and an integer giving the number of strings in the array (Figure 1).

This article is not about sorting, so I shall say very little about the algorithm: basically in the inner loop, array elements are moved downwards in the array until they reach the correct position, and so the array is sorted from 0 to i each time round the outer loop. This is not supposed to be the most efficient sorting routine in the world, or even the best implementation of insertion-sort, so please don't write in on that score.

(Incidentally, all listings have been compiled and tested with the Zortech V2.1 and GNU V1.37 C++ compilers, so they should work for you.)

Suppose we wanted to count how many comparisons were made during a sort, and how many times data elements were moved. This information would be useful in deciding upon the correct data structure,

```
#include <string.h>
#include <stdio.h>


#ifdef NDEBUG
#define INC(x)
#else
#define INC(x) x++
#endif


void isort(char **a, int n)
{
  int n_cmp = 0, n_ass = 0;


  char *p;
  int i, j;
  for (i = 0; i < n; i++)
    {
      INC(n_ass);
      p = a[i];
      for (j = i-1; j >= 0; j--)
       {
         INC(n_cmp);
         if (strcmp (p, a[j]) > 0)
           break;
         INC(n_ass);
         a[j+1] = a[j];
       }
      INC(n_ass);
      a[j+1] = p;
    }


#ifndef NDEBUG
  printf ("No of assignments:\
           %d\n", n_ass);
  printf ("No of comparisons:\
           %d\n", n_cmp);
#endif
}
```

Figure 2 - Sort routine with code to gather statistics

```
#include <stdio.h>

class Statistic
{
  const char *name;
  int count;
public:
  Statistic(const char*);
  ~Statistic();
  void operator++();
};

inline Statistic::Statistic(const char *n)
{
  name = n;
  count = 0;
}

inline void Statistic::operator++()
#ifdef NDEBUG
  {}
#else
  { count++; }
#endif

inline Statistic::~Statistic()
{
#ifndef NDEBUG
  printf ("%s: %d\n", name, count);
#endif
}
```

Figure 3 - Complete implementation of class statistics

algorithm, access mechanism and so on in a larger system.

Doing it in C

The first implementation to gather these program statistics stays with pure C, and defines two counters `n_cmp` and `n_ass`. A macro `INC()` is defined so that the counting code can be taken out when building a production version of the program. The symbol `NDEBUG` is used quite often (eg in the ANSI standard include file ASSERT.H) to tell the compiler whether or not to include debugging code, and so I have followed normal practice here. When debugging is complete, use the compiler flag '-DNDEBUG' to define the symbol and hence remove all overhead. Figure 2 shows the reworked version.

Consider some of the problems associated with this implementation. As mentioned earlier, for each new count, I have to define it at the top of the function, and also add a `printf()` to output the result. If I am gathering data in several functions across the whole run of a program, this `printf()` will have to go at the end of `main()`, which is probably in a different file altogether.

Suppose we discover that `int` isn't big enough on a particular machine to hold the count, so we decide to use `long` instead. Then all the declarations and `printf()` references have to be altered and, of course, it is extremely easy to forget to change one of the `printf()`s because no type-checking is done on its format string arguments.

Maybe later we will decide to ship beta-test versions of the system including the statistic-gathering code, and log the data in a file. All of the `printf()`s will have to be changed, and code must be added to open and close the log file each time data is output.

All of these problems stem from the fact that the implementation of our counters is totally exposed, and this is what happens all too often when you hack something up quickly to do some small task. Quick hacks can remain in the code for years, causing problems when the system has to be maintained or enhanced.

C offers a few data-hiding features: we can use a `typedef` instead of `int` for the counter variables, so that the actual type can be easily altered, and we can declare a function in another module to do the data output. However, with C++ we can declare a whole new type to add to the language, which makes the whole thing much neater and simpler.

Class Statistic

Figure 3 shows a class `Statistic`, which I developed over a few days during the optimisation exercise mentioned earlier. The various facilities were extended and then refined in use, and I ended up with what you see here.

The constructor takes as an argument the name of each `Statistic` and zeros the count. The name is remembered for later, as it is used in the destructor.

The `++` operator is defined for objects of class `Statistic`, incrementing the count, but no other arithmetic can be done with them; in particular it is impossible to zero the count accidentally.

As an improvement on the `INC()` macro in the C solution, `operator++` is defined as an inline member function, with two possible implementations. Just as before, we use `NDEBUG` to differentiate between them: if `NDEBUG` is defined, no code will be generated when `++` is applied to an object of class `Statistic`. In this way, we restrict the ugly `#ifdef` code to a single point, we avoid the introduction of another identifier, and we get to use the traditional C syntax for incrementing without compromising on efficiency.

The really clever bit is that the destructor is given the task of outputting the name and final count. This means that the data will be output when a `Statistic` goes out of scope, and so all we have to do in the insertion-sort example is to declare a couple of `Statistics` at the top of the block, and we get the printout automatically when the function returns.

To gather data over a whole program run, declare `Statistics` with file scope, so that they will get destroyed after the program exits. In this way, we can avoid putting code into `main()` to output the counts. Note that there is a subtle portability problem here: C++ does not specify the

```
#include <string.h>
#include "statistc.h"

void isort(char **a, int n)
{
  Statistic n_cmp("Number of comparisons");
  Statistic n_ass ("Number of assignments");

  char *p;
  int i, j;
  for (i = 0; i < n; i++)
    {
      n_ass++;
      p = a[i];
      for (j = i-1; j >= 0; j--)
              {
                n_cmp++;
                if (strcmp (p, a[j]) > 0)
                  break;
                n_ass++;
                a[j+1] = a[j];
              }
      n_ass++;
      a[j+1] = p;
    }
}
```

Figure 4 - Sort routine using statistic objects

WE MAKE THE PIECES FIT

pcANYWHERE™ IV

pcANYWHERE IV - the easiest way to resolve user problems from afar. Corporate information centres, software houses and computer dealers can set up diagnostic, support and operational systems, including access to local area networks via dial-up and leased lines. One pcANYWHERE IV package provides the software necessary for both sides - host and remote - of a PC-to-PC connection.

* Full control of a host PC from a local PC or terminal allows almost any PC software to be used from a remote site.

* Graphics support for Hercules, CGA, MCGA, EGA and VGA.

* Call-back and password security.

* Fast error-checked file transfer.

* UK modem support.

£150

CHAIRMAN™

Set up your own Electronic Mail, Bulletin Board or Information System quickly and painlessly using

CHAIRMAN...
£210 to £710

Supports up to 6 simultaneous lines on one PC, or unlimited callers in the network version. Security checking, file transfer, conferencing, on-line surveys, binary mail transfer. Fully customisable even to the extent of running database applications.

ASCOM IV™

ASCOM IV

For general purpose communications via modems or direct connection, this powerful menu or command-driven package allows easy use of electronic mail systems, access to mini's and mainframes and other on-line services.

Dial directory, powerful script language, selection of file transfer protocols including XMODEM, YMODEM and KERMIT. Terminal emulation includes VT220 and VT100, and can even be used as a terminal to pcANYWHERE III...

£170

£395

Using pcANYWHERE IV/LAN, everyone can have complete, high-speed, PC-to-PC remote control ACROSS, INTO and OUT OF an IPX or NETBIOS compatible local area network. It allows one workstation to control another workstation on the LAN, or on another LAN, or control a stand-alone PC at a remote location.

pcANYWHERE IV/LAN's one-to-many capability allows support personnel to monitor multiple PCs. They can see problems, share solutions and train users right on their own PCs.

As well as supporting NASI/NCSI for dedicated communications servers, a gateway function unique to pcANYWHERE IV/LAN allows any workstation to become a non-dedicated communications server on the LAN.

pcANYWHERE™ IV/LAN

Authorised DMA distributor.
Trade and OEM enquiries are welcome.
Standard terms are CWO.
Prices exclude delivery and VAT.

To order, call us now on

(02406) 6365

VISA MasterCard Access

Telesystems Ltd

3 WYCOMBE ROAD, PRESTWOOD, BUCKS. HP16 0ND

pcANYWHERE IV, pcANYWHERE IV/LAN, CHAIRMAN and ASCOM IV are trademarks of Dynamic Microprocessor Associates Inc. Other brand and product names are trademarks of their respective holders.

CIRCLE NO. 433

order in which destructors from different modules get called, and so we cannot use 'cout <<' in the Statistic destructor for fear that cout will have been destroyed before the Statistic object.

I have declared all members of Statistic inline, so that you can type it into a file STATISTC.H, include that in your C++ programs and start to use it immediately, but the destructor should probably be coded out-of-line in a separately compiled C++ file which you link with your system. Then, the exact format in which the count is output, whether it goes to stdout, stderr, a log file or whatever, can be changed without recompiling the places where Statistics are used.

It is, in general, good C++ programming practice to define inline methods outside the class declaration, so that they can be easily moved into their own module if appropriate. The alternative, putting the code beside the methods inside the class declaration, requires extra editing if you decide to make such a change, and can make the code harder to read.

The design benefits from C++'s principle of 'you don't pay for what you don't use'

Conclusion

If you take a look at Figure 4, you will see that our sort routine now looks a lot neater. Surely no argument that this is a big improvement.

Much of the power of OOP stems from encapsulation: each program element is defined and used in terms of a public interface, while the actual data and implementation that it uses are hidden, and can be changed without affecting the rest of the system. I hope that even this short example can show how useful and simplifying encapsulation can be within any programming project.

In C++, constructors and destructors are primarily intended for initialisation and clean-up of objects, but as you can see they can offer a powerful new programming mechanism too. It is even possible to have a class do useful work with no member functions other than a constructor and destructor!

As I said, there is no dynamic binding and no inheritance in this article. Nonetheless, my Statistics clearly are objects, and the fact that they do not suffer any virtual function overhead when used is merely a win for C++'s principle of 'you don't pay for what you don't use'.

EXE

Bryan Boreham is an experienced C++ programmer, who took part in the .EXE 'round table' session with Bjarne Stroustrup. He lives in Middlesex.

Prospero: the Pascal experts

Language Definition

Prospero Pascal is a full ISO standard Pascal, with a whole range of extensions including dynamic length strings, longreals, random access file handling, bit level manipulation, type breaking, include files and separate compilation. Prospero produced the first ever microcomputer Pascal compiler to be validated as conforming to the ISO standard (for the Z80 under CP/M) in 1983, as well as the first validated Pascal compiler for the IBM PC in 1985.

The Package

As well as a compiler, you get a linker, librarian, cross-reference generator, source level symbolic debugger (except for Z80 systems) and a free technical support hot-line.

Prospero Pascal is available for the following environments.

OS/2	£320	Full support for OS/2 and DOS. Full ISO level 1, with Prospero Workbench, the power programmer's choice.
MS-DOS	£240	As above, but without OS/2 support.
PC clones	£86.91	Personal version.
DOS/GEM	£86.91	Full GEM support, integrated development environment.
DOS→CP/M	£480	MS-DOS hosted Z80 cross compiler.
CP/M-80	£320	Amstrad version available for £49.95.
CP/M-86	£320	Including concurrent DOS.
Helios	£640	T800 transputer implementation. Includes language extensions to support parallelism.
Atari ST	£86.91	Full GEM support, integrated development environment. MC68881 co-processor library available for £60.

Prices include UK shipping, but exclude VAT. For information on any of these products, or any of our other development tools, contact us at the address below.

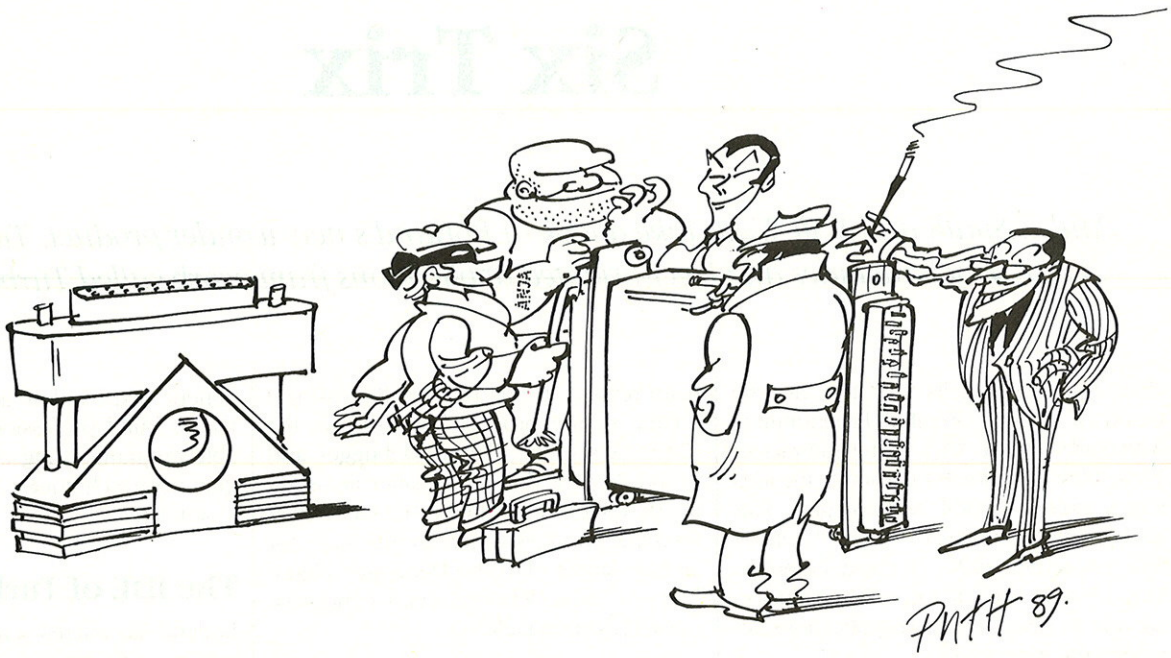
Prospero Software

LANGUAGES FOR MICROCOMPUTER PROFESSIONALS

190 CASTELNAU, LONDON SW13 9DH, ENGLAND TEL: 081-741 8531 FAX: 081-748 9344

CIRCLE NO. 434

5 out of 5 hackers prefer other software protection methods to Hardlock E-Y-E®

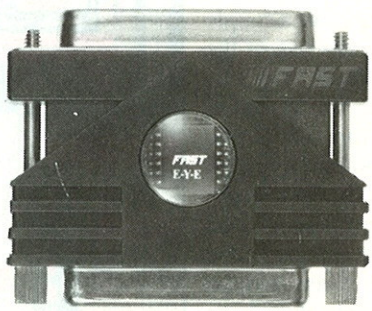


What hackers dislike...
Hardlock E-Y-E was designed using cryptographic principles. It took the experience and know-how of Germany's No. 1 in software protection and the leading edge technology of a US semiconductor company to create the ultimate software protection tool. Hardlock E-Y-E is based on a custom chip featuring secure algorithmic response rather than simple bit swapping or counting schemes.

What software developers like...
Hardlock E-Y-E combines all the features software developers require in a single product: algorithmic response to provide security and an optional non-volatile memory to allow custom configurations. FAST Electronic has made implementation of Hardlock E-Y-E in your software easy. Use HL-Crypt to protect .EXE or .COM files, or incorporate high level language interface routines in your software. The algorithm parameters and the contents of the memory can be programmed in seconds using our Crypto-Programmer card. This unique card guarantees that no one else can burn your original codes. Simply plug the card into any PC slot and start up your own Hardlock E-Y-E workshop.

What your customers will like...
Hardlock E-Y-E allows unlimited backup copies. The device is shipped with the software for the user simply to plug into the parallel interface and forget. Daisy chainability, outstanding reliability (no battery is needed), and the most compact High-Tech design ensure that your customer will accept Hardlock E-Y-E.

What your accountant will like...
Hardlock E-Y-E needs no factory coding. This ensures optimum delivery schedules and stock flexibility. Revenues will go up as software piratry and multiple usage are prevented. Despite its wealth of features, Hardlock E-Y-E's prices remain competitive.



Hardlock E-Y-E programmable, algorithmic response and memory option – all in one.

...As more and more software developers, customers and accountants appreciate the Hardlock E-Y-E device, hackers like it less and less.

MAGNIFEYE

Order your demo unit today. Contact Magnifeye,
235-239 Walmer Road, Walmer Studio #6, W11 4EY, Telephone 071 221 8024, Fax 071 792 3449.

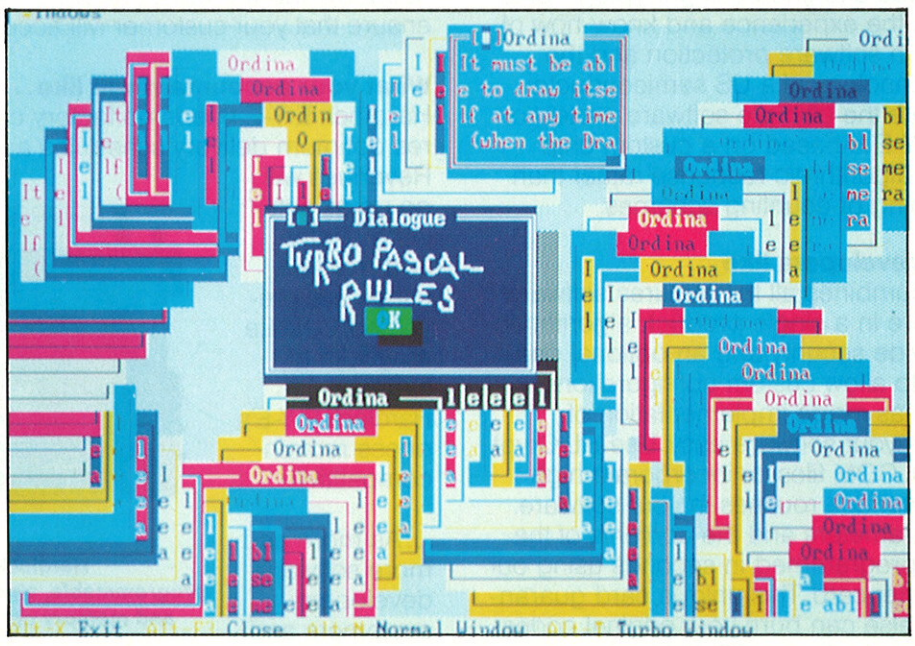
CIRCLE NO. 390

Six Trix

Paul G Smith and Will Watts take a look at Borland's new wonder product, Turbo Pascal V6.0, which includes an object-oriented applications framework called Turbo Vision.

Since Borland took its first step into the world of Object Oriented Programming with Turbo Pascal V5.5 in the summer of 1989, it has been keen to promote the idea that it excels in OOP technologies. This spring saw the launch of Turbo C++. On the 5th November 1990, Borland launched Turbo Pascal V6.0, the first PC product to include an object-oriented applications development framework.

This article should be thought of as a product preview, rather than a formal or comparative review, because the first copies of Turbo Pascal V6.0 arrived in the UK only a couple of weeks before the deadline for this issue. We looked at version 6.0 of the Turbo Pascal Professional package. Turbo Pascal has been around since 1983, when Borland first introduced it's aggressively priced $49.95 product.



Although Turbo Pascal 5.5's version number suggests that it was an intermediate release of the product, there were more changes to the Turbo Pascal language between V5.0 and V5.5 than between V5.5 and V6.0. The significance of V6.0 is in the rest of the package.

For a start, there is a completely new integrated program development environment (Borland habitually uses the acronym 'IDE'). There is an updated version of the Turbo Pascal compiler, linker and integrated debugger. The documentation has been revised. If you buy the Professional edition of the product you also get the Turbo Assembler, Turbo Debugger and Turbo Profiler. (NB These latter items are not described in this article; but see *At their breaking point* elsewhere in this issue, for an assessment of Turbo Debugger. Figure 3 shows Turbo Debugger's very impressive class navigation facility.)

The compiler has a few revisions, including the addition of a directive to declare private fields and methods of classes. A built-in inline assembler has been added, removing the need for tortuous hand machine-coding. As well as the IDE's built-in compiler, there are *two* command-line versions of the compiler. One of these (available only in the Professional edition) runs in protected mode and uses extended memory to allow you to build very large programs.

Included with every copy of Turbo Pascal V6.0 is the Turbo Vision framework, a generic text-window application you can use to build professional quality deliverable programs using object oriented programming techniques. A lot more on Turbo Vision later.

The IDE of Turbo

Borland has offered some sort of integrated programming environment for Turbo Pascal since V1.0 in 1983. Today's offering is a lot more substantial, and will be familiar to users of Turbo C++. The IDE creates an environment within which you can write, compile, link and debug programs. It is very nice to work with, having a well designed user interface and consistent operational rules. Let's take a closer look. (Please refer to Figures 1 and 2 for pictures of the IDE in operation.)

When you launch the IDE, you are taken into a text-only world of windows, pull-down menus, and mouse and keyboard operation (you can use the keyboard to control windows and use menus if you don't have, or don't want to use, a mouse. However, in the opinion of WRW, the design favours mouse users to the disadvantage of keyboard-only users). Across the top of the screen is a menu bar containing System, File, Edit, Search, Run, Compile, Debug, Options, Window and Help menus. At the bottom of the screen is a status line, which also displays function key assignments. In between is the area in which the editing windows,

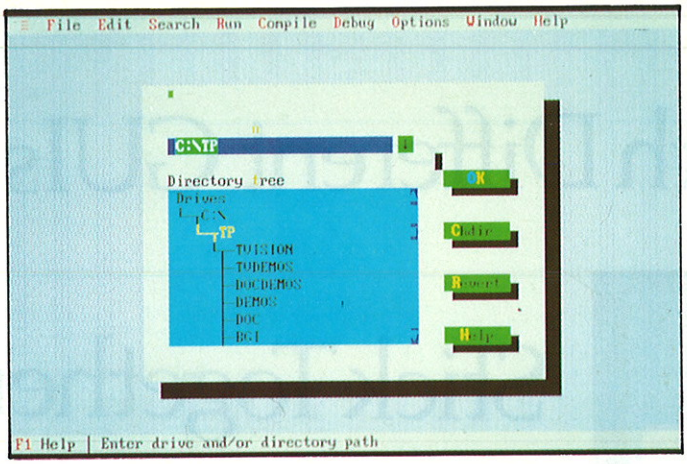


Figure 1 - Changing directory in the IDE

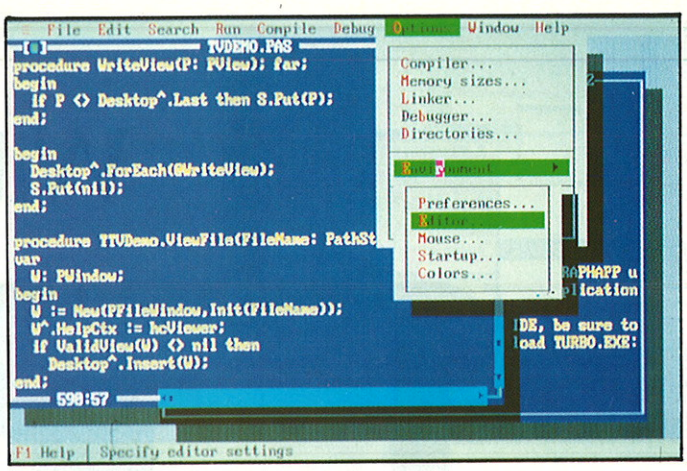


Figure 2 - The IDE's Options menu

menus, and dialog windows are displayed. If you have an EGA or VGA display adapter (plus high resolution eyesight) you can select between the default 24-line screen display and a more concise 43 or 50 line display. You can switch between the two modes on the fly without using a setup program.

The IDE can open many windows at once, subject only to memory constraints. Windows are used for many different purposes, but they all have a consistent appearance. Open windows are layered, and may overlap or obscure one-another. The top-most window is the 'active' one and is distinguished by a double-lined border. Editing windows can be zoomed and resized, moved, scrolled, and closed using either the mouse or the keyboard. Other kinds of windows don't necessarily offer all these possibilities: for instance, a dialog box won't be resizable or scrollable. The IDE editor can cope with files as large as 1 MB by buffering them to disk or extended memory. It still supports most of the old-style (V5.5) Turbo Pascal key bindings, as well as giving you new menu and mouse commands.

The range of operations you can call upon the IDE to perform is impressive. The Edit menu offers functions for cutting, copying and pasting text (note that cutting and pasting has been extended beyond the crude, Help text only facility offered in V5.5. You can now move text between file buffers as well). There is a command for restoring the last line edited (it isn't a full 'undo' command), and access to the Clipboard window, which contains all the text you have cut or copied for later reuse. The Search menu lets you search for text, replace text, jump to any line in the file, and search for specific procedures or errors during debugging sessions. Powerful grep-like regular expression matching is supported.

The Run, Compile, and Debug menus control the program building and debugging process. The Run menu lets you run the program (which will be optionally rebuilt if you have changed any source files), reset a debugging session, execute up to a temporary breakpoint at the position of the cursor in the current source file, trace into and step over procedures, and choose the parameters to be supplied in the command line of the program being run. The Compile menu has commands that, respectively, compile the current source file, 'make' the current project, and force a complete rebuild of the whole of the current project. It also lets you choose whether files are compiled to memory or disk, and select the name of the project's primary source file. The Debug menu controls the operations of the integrated debugger, offering functions that let you evaluate or modify variables and expressions, control watchpoints and watch expressions (used to see how variables change as your program executes), and manage breakpoints.

The Windows menu controls the position and layout of windows, letting the non-mouse user do window positioning and resizing. It also has commands that open a 'call stack' window (that can be used to trace how your program reached the currently executing procedure) and toggle between seeing your program's output in an IDE window and letting your program use the entire screen.

The Help menu manages the IDE's built-in context-sensitive help subsystem. Help is included on most of the IDE and Turbo Pascal. You can navigate downwards from a table of contents, or search for help on the item in the edit window that is under the cursor. The help text is thoroughly cross-referenced (as usual with hypertext schemes, a cross-referenced item appears highlighted in the text. Clicking on the item takes you to the relevant page).

The IDE is highly configurable, through the Options menu, through various command line options at start-up and through TEML, the Turbo Editor Macro Language. The Options menu gives you access to many configuration dialog boxes including compiler, linker and debugger setup (it is here that you choose whether to use the integrated debugger or the Turbo Debugger). It also has dialog boxes for default directories, environment settings including editor, mouse and general preferences, and also screen colour assignments. You can save and restore options settings on disk.

The Macro Language is for real keenos. In order to use it, you

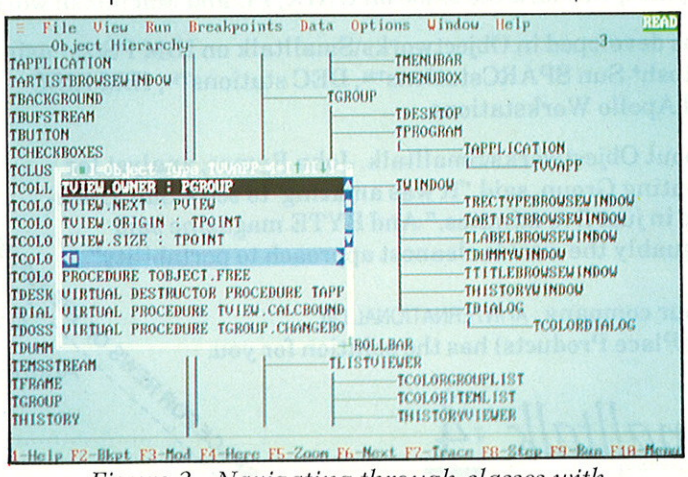
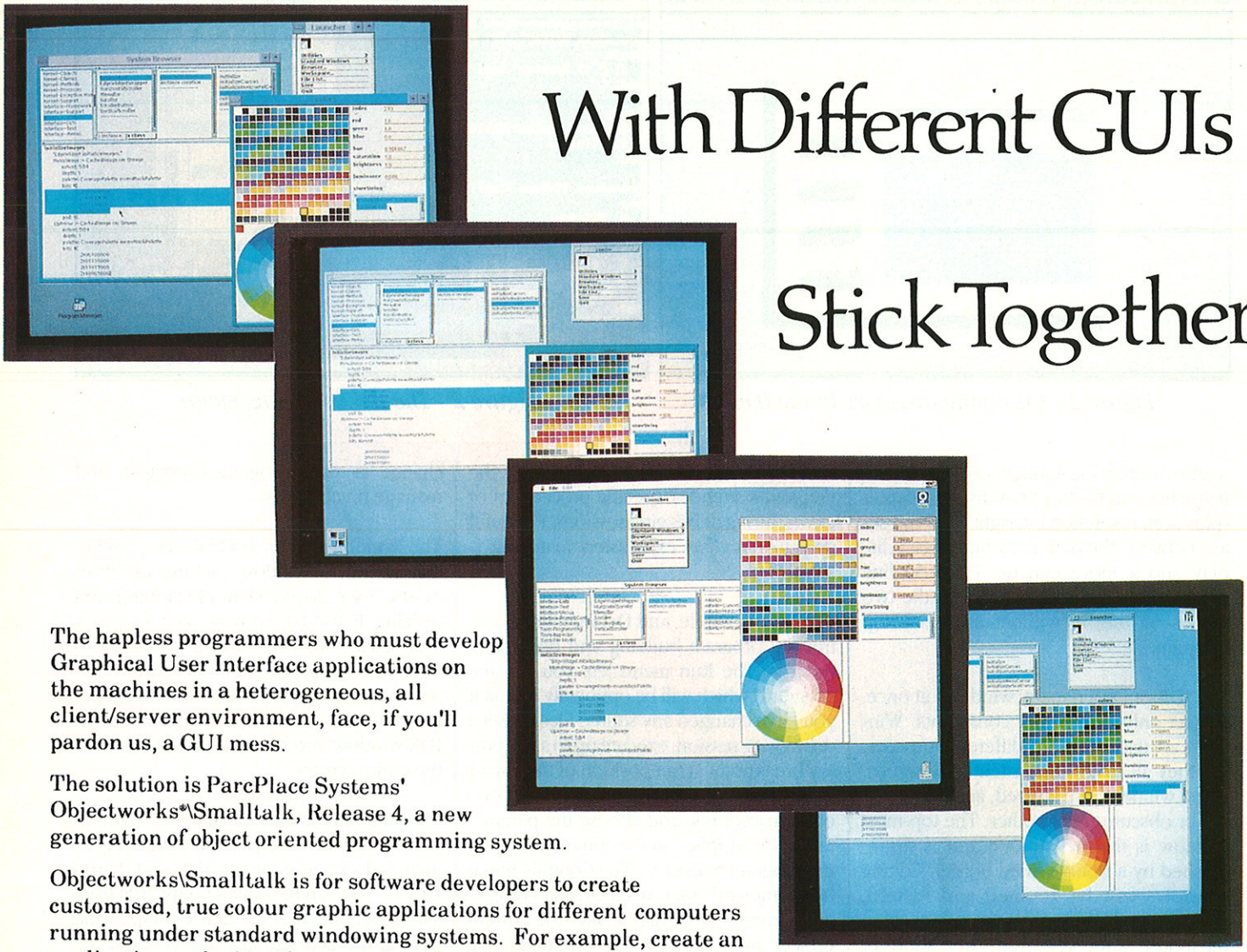


Figure 3 - Navigating through classes with Turbo Debugger

How Does A Company With Different GUIs Stick Together?



The hapless programmers who must develop Graphical User Interface applications on the machines in a heterogeneous, all client/server environment, face, if you'll pardon us, a GUI mess.

The solution is ParcPlace Systems' Objectworks®\Smalltalk, Release 4, a new generation of object oriented programming system.

Objectworks\Smalltalk is for software developers to create customised, true colour graphic applications for different computers running under standard windowing systems. For example, create an application under Motif and run it under OpenLook or any other X Window™ System. Or on Macintosh, or PCs under Windows 3.0. The dynamic compilation automatically integrates your application with the platform windowing system you choose.

Also, Objectworks\Smalltalk will enable you to develop and port colour applications with an advanced true colour implementation.

Then there's the Smalltalk Portable Imaging Model (SPIM). With it, developers have only one set of Portable Objects to learn; SPIM does the mapping to the platform graphics facilities and windowing systems. Your application graphics, will look the same on UNIX, PC and Macintosh workstations.

In fact, you can run applications developed in Objectworks\Smalltalk on IBM PS/2s® using Microsoft Windows 3.0, Macintosh®, Sun SPARCstations™, DEC stations™, IBM RISC System 6000™®, HP 9000™ and Apollo Workstations.

There is already a lot of talk about Objectworks\Smalltalk. John Rymer, analyst for Patricia Seybold's Office Computing Group, said,"It was amazing to see a Sun OpenLook application move to a Mac in just five minutes." And BYTE magazine said "Objectworks offers what is arguably the worlds cleanest approach to portability."

So if you have a GUI mess in your company, AI INTERNATIONAL Ltd (the sole UK distributor of ParcPlace Products) has the solution for you.

Objectworks\Smalltalk RELEASE 4

CIRCLE NO. 391

Also available, Objectworks\C++, Release2.

Objectworks®\Smalltalk, Release 4 & Objectworks®\C++, Release 2 are trademarks of ParcPlace Systems Inc. All other brands are trademarks of their respective holders. ®1990 AI INTERNATIONAL Ltd

WATCH THIS SPACE FOR NEWS OF THE 1991 SERIES OF OBJECTWORKSHOPS

AI INTERNATIONAL

Name: .....

Company: .....

Address: .....

.....

.....

Telephone: .....

EXE 12/90

For more information please contact Artificial Intelligence International Ltd, Greycaine Road, Watford, WD2 4JP or Call us on 0923 247707

```
type
  cursor = object(graphicObject)
      procedure draw;
      procedure moveTo
                (hPos, vPos: INTEGER);
    private
      hLoc:     INTEGER;
      vLoc:     INTEGER;
      overlay:  BitMap;
      mask:     BitMap;
      procedure changeCursor
            (overlay, mask: BitMap);
    end; {cursor}
```

Figure 4 - Using the 'private' keyword

have to pass a prepared script through a special compiler to produce a configuration file which the IDE sucks in at start-up. You can use it to force the IDE to respond to the same keystrokes as the editor you were brought up on as a child, or, if you get ambitious, you can set up fancy macros which generate procedure templates.

To get the best out of the IDE you will want to fine tune the configuration. The default is not necessarily the best for your system, especially if you want to make good use of extended memory. Paul had to adjust the configuration to take full advantage of his 33 MHz 386 machine's 4 MB of extended memory. Even so, he was still occasionally tight on memory. One program that he ported to Turbo Pascal V6.0 could never be built inside the IDE - we had to use the command-line compiler. This isn't a serious criticism, though: the IDE is capable of dealing with all but the largest projects and the limitations are those of real-mode PC operation.

```
procedure PrintDecimal
                (Decimal : Word);
{ Recursive procedure,
  prints parameter as a decimal }
label
  PrintIt;
var
  NewDecimal : Word;
begin
  asm
    mov dx, Decimal
    cmp dx, 10
    jb  PrintIt
    mov ax, dx
    xor dx, dx
    mov cx, 10
    div cx
    mov  NewDecimal, ax
    push dx
  end; { asm }
  PrintDecimal(NewDecimal);
  asm
    pop  dx
PrintIt:
    add dl,'0'
    mov ah,2
    int $21
  end; { asm }
end;
```

Figure 5 - Using the Inline assembler

When you do start to push the barriers of what can be done inside the IDE, you can use the command-line versions of the Turbo Pascal compiler and linker. Borland provides two: TPC.EXE operates in 8086 real mode, TPCX.EXE (in the Professional edition only) operates in protected mode on 80286 (or better) based machines. Both of these compilers let you compile larger programs than is possible under the IDE. The latter, which uses a bought-in DOS extender quaintly called 'Turbo Driven' can compile extremely large programs, provided you have at least 1 MB of extended memory.

Language changes

There are few changes to the Turbo Pascal language in version 6.0. The most important is the addition of a reserved word that allows fields and methods of classes to be defined as `private`, rather like C++ does. A private field or method is one that can only be referred to inside the unit within which the object type is declared. An example of the syntax is shown in Figure 4.

New to version 6.0 is the compiler's ability to generate (real mode) 80286 code. If the `$G+` compiler directive is set, the compiler makes use of some additional 80286-specific machine code instructions (such as `ENTER`, `LEAVE`, `PUSH <immediate>` and extended `IMUL` and shift operations) to improve the generated code.

The `$X+` directive enables 'extended syntax', which turns out to be the ability to ignore the return from functions. Previously, if you wished to stop the program until the operator pressed a key, you had to write

```
WriteLn('Press a key...');
dummy := ReadKey;
```

and discard the contents of `dummy`. Under extended syntax, you just say

```
ReadKey;
```

by itself, and the incoming keystroke is automatically flushed down the bit bucket. C programmers, who have always been able to do this anyway, will wonder what the fuss is about. Incidentally, when we spoke to Borland US's David Intersimone about this new release, he hinted that this directive was closely tied up with the way that the Turbo Pascal language was going to evolve.

The inline assembler, mentioned earlier on, is invoked with the `asm` keyword. An example of its use is given in Figure 5. As you can see, you may mix Pascal to Assembly language as much as you like. Writing the fragment in Figure 5, we couldn't be bothered to investigate TP's calling conventions, so we simply wrote the procedure's call to itself in Pascal.

```
program Simple;

uses App;

var
  MyApp: TApplication;

begin
  MyApp.Init;
  MyApp.Run;
  MyApp.Done;
end.
```

Figure 6 - The simplest Turbo Vision program

For those of you who enjoy pain, the old machine code `inline` statement is still supported. Note that Turbo Pascal V6.0 is syntactically entirely upwards-compatible with V5.5: all your old stuff should recompile straight off. However, as is traditional between consecutive releases of dear old TP, the format of the binaries has been tweaked; so if you rely on third party TPUs and you don't have the source, then you're stuffed pending an upgrade. However, it is our contention that you will, in any case, be junking all your user-interface libraries.

Overlays, that other favourite target of inter-version alteration, have been changed, but fairly minimally (the algorithm which controls the heap manager has been altered). References to `FreeMin` must be deleted, and those that depend upon `FreePtr` will need updating. Unlike C++ users, Pascal people have not been granted VROOM overlays.

Turbo Vision

So, at last, to the best bit of Turbo Pascal V6.0. It is called Turbo Vision, and it is a really excellent object oriented application framework. What's so special about it? Hard to explain in a few words. Turbo Vision contains the framework of a complete text-windows applications package, including building blocks for important components. Imagine an integrated set of libraries to implement a text-mode version of Microsoft Windows - containing all the stuff to draw windows, track mouse movements, channel events, work out which window is 'on top' and so on - and you are not too far from the mark.

The Turbo Vision 'generic application' already knows how to load itself, present a text-windows mouse and keyboard event-driven user interface, store information on disk and so on: everything, in fact, except the application-specific functionality that is unique to your own projects. To create new applications, you simply subclass and selectively override the Turbo Vision classes: using object oriented programming tech-

niques there is no need to modify source code as one often has to with traditional user interface libraries. The simplest Turbo Vision application is just a few lines long (see Figure 6). This does nothing except present the standardised Turbo Vision user interface (an empty menu bar on the top line, 23 lines of 'breeze block' space characters and a status line with `Alt-X Exit` written on it). For a more impressive example of what can be done with Turbo Vision, you need look no further than the IDE itself.

All Turbo Vision objects belong to the object hierarchy shown in Figure 7. A dialog box (`TDialog`) is a type of window (`TWindow`) which is a type of group (`TGroup` - anything which can contain other displayable objects) which is a type of view (`TView`, a displayable object) which is a type of object (`TObject` - the generic Turbo Vision base object). Here are the OOP rules of design abstraction neatly played out.

How easy is it to use? Figure 8 shows some code, plucked from one of the numerous examples, to set up a menu bar with a couple of drop down menus. As a choice of example code, this is a bit naughty because at first glance it looks like hell. At second glance, and given the extra knowledge that Turbo Vision menus are constructed as linked lists, that `NewItem` returns a pointer to the menu item it has just created and is passed the list it is building on as its last parameter, it begins to come into focus. The main problem with Turbo Vision is that you have to learn the behaviour and names of a lot of objects before you can get into it (but not nearly as many as for something like Windows). This learning process is sped along by the excellent documentation, both printed and online. Once you have cleared this initial hurdle, writing Turbo Vision applications is a delight.

Be Persistent

Objects may be a great programming convenience, but, with their multiple components, they are a terrible bother to set up, read/write to disk and so on. To combat this, Borland has developed a system of *persistent objects*. All classes derived from the base class `TObject` (which includes all of Turbo Vision types) can be made to work with *streams*. A stream is like a random access file; but you can store and retrieve *mixed* object types in it. A system of registration enables the mechanism to 'know' the type of an object as it is retrieved. In order to make your own object type 'streamable', all you need do is override a couple of methods, `Load` and `Store`, to handle your instance data, and register the object. This is a very useful and important feature, but there is not enough space here to cover it in any depth. Here is a good example of its use: when you start it up, the IDE reloads the desktop, complete with all its windows and views that you had at the end of the last session. Using streams, this can be accomplished in about five lines of code.

Turbo Vision also offers collection classes, for easy handling of multiple instances of objects, and *resources*, which are streams plus a simple database key system which allows you to retrieve objects using unique string references.

Documentation

Turbo Pascal V6.0 comes with four perfect bound manuals: *User's Guide*, *Programmer's Guide*, *Turbo Vision Guide* and *Library Reference* (Borland wishes to draw attention to the fact that these have been specially reinforced so, unlike previous offerings, it is possible to open them flat without breaking their spines). The User's Guide contains introductions to the IDE and the Pascal Language. The Programmer's Guide contains the definition of the Turbo Pascal language and various miscellaneous reference material, such as how to use the assembler. The Library Reference documents all the conventional (ie non-class) library material, including BGI - the Borland Graphics system. The Turbo Vision Guide contains both the tutorial and reference material for Turbo Vision. As is usual with Borland, the standard of documentation is high - the material is well-presented and easy to understand. Here and there a few errors have crept in (some are picked up in the README file), but nothing seriously amiss. One complaint: the write-up on some of the extra utilities (for example: MAKE and the IDE's script language) has been banished from the manuals to text files on disk. Surely MAKE is sufficiently

The Apple inheritance

Turbo Vision owes a great deal to Apple's MacApp applications framework. Like Turbo Vision, MacApp has a hierarchy of objects descending from the base class `TObject`, including classes like `TView`, `TApplication` and so on. However, Turbo Vision is by no means a direct copy of MacApp: Borland has made a number of distinct design decisions and ended up with a product quite its own.

Apple started working on the predecessor of MacApp in the early 1980s, as a part of the Lisa project. They implemented a language called 'Clascal' (Pascal with classes) and wrote an applications framework on top of it. In common with MacApp and Turbo Vision, the Lisa Toolkit implemented a generic application that contained most of the user interface and data management functions shared by event-driven graphical user interface applications. Using object oriented programming techniques this could easily be extended to take care of applications-specific functionality. In 1983 Apple released the Object Pascal report, and started work on a rewrite of the Lisa Toolkit called MacApp. MacApp is now in its second major release, having been available for five years to Apple software developers, and has been used as the foundation of a great many successful software products. It is one of the most popular applications frameworks, and has been the inspiration of other class libraries like the Think Class Library and ETH Zurich's ET++ for C++.

There are a great many parallels between MacApp and Turbo Vision. Both are intended to implement the framework and core functionality of an application that implements a standardised user interface in a windowing mouse and keyboard event-driven environment. The underlying program structures (and many of the class names!) are quite similar, and it is clear that Borland took a good look at MacApp before they set off to invent their own product. For instance, Apple has a `TEvtHandler` class, responsible for receiving and dispatching events, from which are descended classes like `TApplication` and `TView`; Borland has made its `TView` class equivalent to Apple's `TEvtHandler`. Turbo Vision is a good deal less complicated than MacApp, though, which makes it a lot easier to learn and work with. A good deal of this is down to the fact that Turbo Vision supports a text-mode user interface, whereas MacApp has to deal with all the complications of the Macintosh Toolbox API and the Macintosh graphical environment.

More than once, at seminars and conferences, I have heard Borland staff talk condescendingly about Apple's 'early research efforts' into object oriented programming techniques using Object Pascal. It's interesting that nowhere in the Borland documentation or launch information do they refer to the debt they owe to Apple: this is one inheritance that shouldn't be forgotten.

FTN77/386

FULLY FEATURED FORTRAN COMPILER FOR YOUR 386

FEATURES, FUNCTIONALITY AND OUTSTANDING PERFORMANCE COMBINE TO MAKE FTN77/386 THE FIRST CHOICE FOR PROGRAM PORTING AND DEVELOPMENT

- ☐ **The FASTEST PC Fortran compiler around** – 13,000 lines per minute on a 16MHz IBM PS/ 2 Model 80.
- ☐ Compiled programs exploit the 386 hardware FULLY, enabling you to address up to 4 Gigabytes of memory.
- ☐ Full VIRTUAL MEMORY capabilities.
- ☐ ANSI Fortran 77 plus mainframe extensions.
- ☐ Support for 80287, 80387 and/or Weitek coprocessors.
- ☐ Coprocessor emulation for non-numerical programming.
- ☐ Runs under MS-DOS.
- ☐ Optional global optimisation *or* checkout mode with diagnostics.
- ☐ Full window-based source level debugger.
- ☐ Currently the *only* 32-bit 386 PC compiler to appear in the NCC list of ANSI validated Fortran compilers.
- ☐ Supplied with a comprehensive, fully indexed reference manual.
- ☐ Allows libraries to be linked dynamically to programs during execution. Dynamic linking means that EXE files are kept small.
- ☐ Contains a full 32-bit in-line symbolic assembler with window-based debugger.
- ☐ Interface to real mode programs and libraries.
- ☐ Selection of graphics libraries available.
- ☐ NAG Fortran Workstation Library and NAG Graphics available.
- ☐ Fully integrated with the DESQview/386 multi-tasking/ windowing software.
- ☐ Novell Btrieve interface.
- ☐ Provides a library of over a hundred routines for MS-DOS access, non-standard file manipulation, window management, graphics, etc.

SALFORD SOFTWARE MARKETING LTD
COMPUTING CENTRE · UNIVERSITY OF SALFORD
SALFORD · M5 4WT · ENGLAND
Telephone (+44) 061 745 5678
Telefax (+44) 061 745 5666

FTN77/486 AVAILABLE NOW!

*MS. DOS is a trademark of Microsoft Corporation.
IBM and PS/2 are trademarks of International Business Machines Corporation.
DESQview is a trademark of Quarterdeck Office Systems. Btrieve is a trademark of Novell Inc.

CIRCLE NO. 392

important to merit proper documentation?

The online documentation is nearly excellent (this is high praise indeed from Will the Hypertext Hater), especially in its coverage of Turbo Vision. For example: each description of a class contains a diagram showing its position in the Turbo Vision hierarchy. Our complaints, which could easily be fixed, are 1) that there are a few rough edges in the hypertext links, for example: you cannot directly discover, given the name of one Turbo Vision constant, in which .TPU is declared; and 2) there is no way of performing a linear search for a text string across the whole database.

Convention dictates that something must be said about installation. It's very easy and sensible, and the only trick that we could think of that Borland seem to have missed is the fact that the installation program does not examine the machine's configuration (to detect extended memory, for example). It could then (optionally) configure the IDE to take advantage of your machine's features.

The Future

What next for Turbo Vision? Turbo C++ users will have read our description of TV with hungry eyes. When will there be a C++ version? Although Borland has certainly not ruled out this possibility, it is emphasising that it has other, higher priorities. The foremost of these is to produce a Windows supporting version of Turbo Pascal. This will become available in the first half of 1991, and will include OOP support for Windows structures. Borland has demonstrated alpha-test versions of this. The hierarchy of Windows classes will not map exactly onto Turbo Vision - Windows, being a full graphical environment, is too complex to allow this - but Turbo Vision applications should be quite easily adapted. Borland also has plans for an OS/2 PM version of the product, and also a DOS extender version, once the DPMI extended memory standard is firmly established.

```
MenuBar := New(PMenuBar, Init(R, NewMenu(
  NewSubMenu('~T~est', hcNoContext, NewMenu(
    NewItem('~B~GI settings...', '', kbNoKey, 0, hcNoContext,
    NewItem('~G~raph', 'Alt-F5', kbAltF5, cmDoGraphics, hcNoContext,
    NewItem('~S~et BGI path...', '', kbNoKey, cmSetBGIPath, hcNoContext,
    NewLine(
    NewItem('~C~hange dir...', '', kbNoKey, cmChangeDir, hcNoContext,
    NewItem('E~x~it', 'Alt-X', kbAltX, cmQuit, hcNoContext,
    nil))))))),
  NewSubMenu('~W~indows', hcNoContext, NewMenu(
    NewItem('~S~ize/move','Ctrl-F5', kbCtrlF5, cmResize, hcNoContext,
    NewItem('~Z~oom', 'F5', kbF5, cmZoom, hcNoContext,
    NewItem('~T~ile', '', kbNoKey, cmTile, hcNoContext,
    NewItem('C~a~scade', '', kbNoKey, cmCascade, hcNoContext,
    NewItem('~N~ext', 'F6', kbF6, cmNext, hcNoContext,
    NewItem('~P~revious', 'Shift-F6', kbShiftF6, cmPrev, hcNoContext,
    NewItem('~C~lose', 'Alt-F3', kbAltF3, cmClose, hcNoContext,
    NewLine(
    NewItem('Add ~w~indow','F4', kbF4, cmNewWin, hcNoContext,
    nil))))))))))),
  nil)))));
```

Figure 8 - Creating a Turbo Vision menu bar

Conclusion

For the devilment of it, we asked Andrew King, Languages Product Manager of Microsoft UK, to comment on Turbo Pascal V6.0. He said, 'The Turbo Pascal V6.0 libraries are satisfactory, but they are only for DOS. Borland has done nothing to address programming for Windows 3.0 in this release.' A fair point, but one gets the impression that he had to scratch around a bit to find something bad to say. Frankly, so did we.

Since this is Turbo Pascal, using it locks you into Borland's proprietary syntax and binary object. As a Pascal user, you have a much narrower choice of third party add-ons than your C/C++ brethren. Umm, err...

On the other side of the coin, Turbo Pascal V6.0 is a very good product. Turbo Vision is beautifully designed, extremely powerful, genuinely innovative and fun to use. If you are using an earlier version of Turbo Pascal, than there is no doubt: you should upgrade. If you are thinking about using Pascal, or you need to put together MS-DOS text mode windowed applications, then you should give this product *very* serious consideration.

Turbo Vision is one of those products that is so good that playing around with it has the effect of making you want to use it for real. Will has undertaken a piece of real-life, commercial programming, just in order to satisfy this urge. He promises to report back if it proves any less satisfactory than suggested here. We believe that Turbo Pascal V6.0 is Borland's best effort to date.

EXE

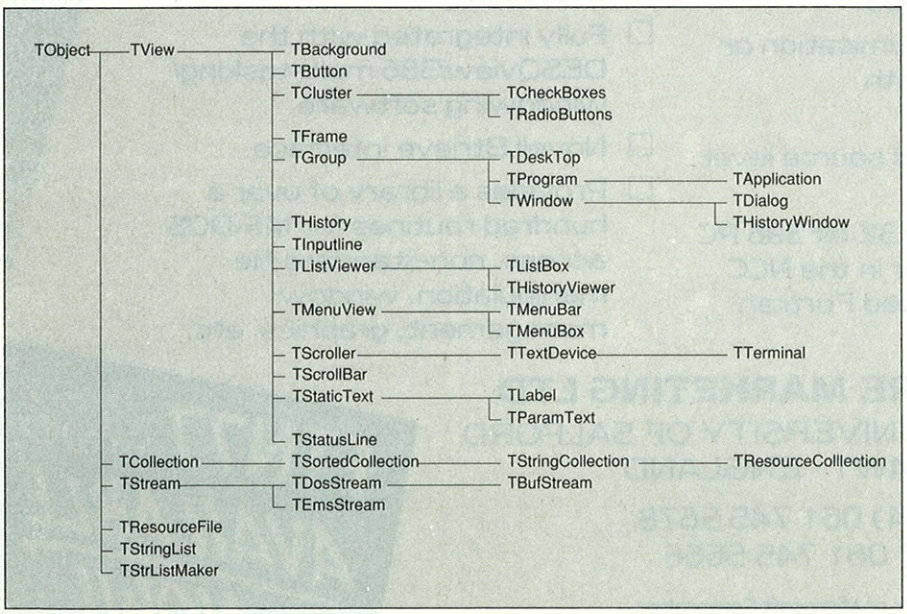
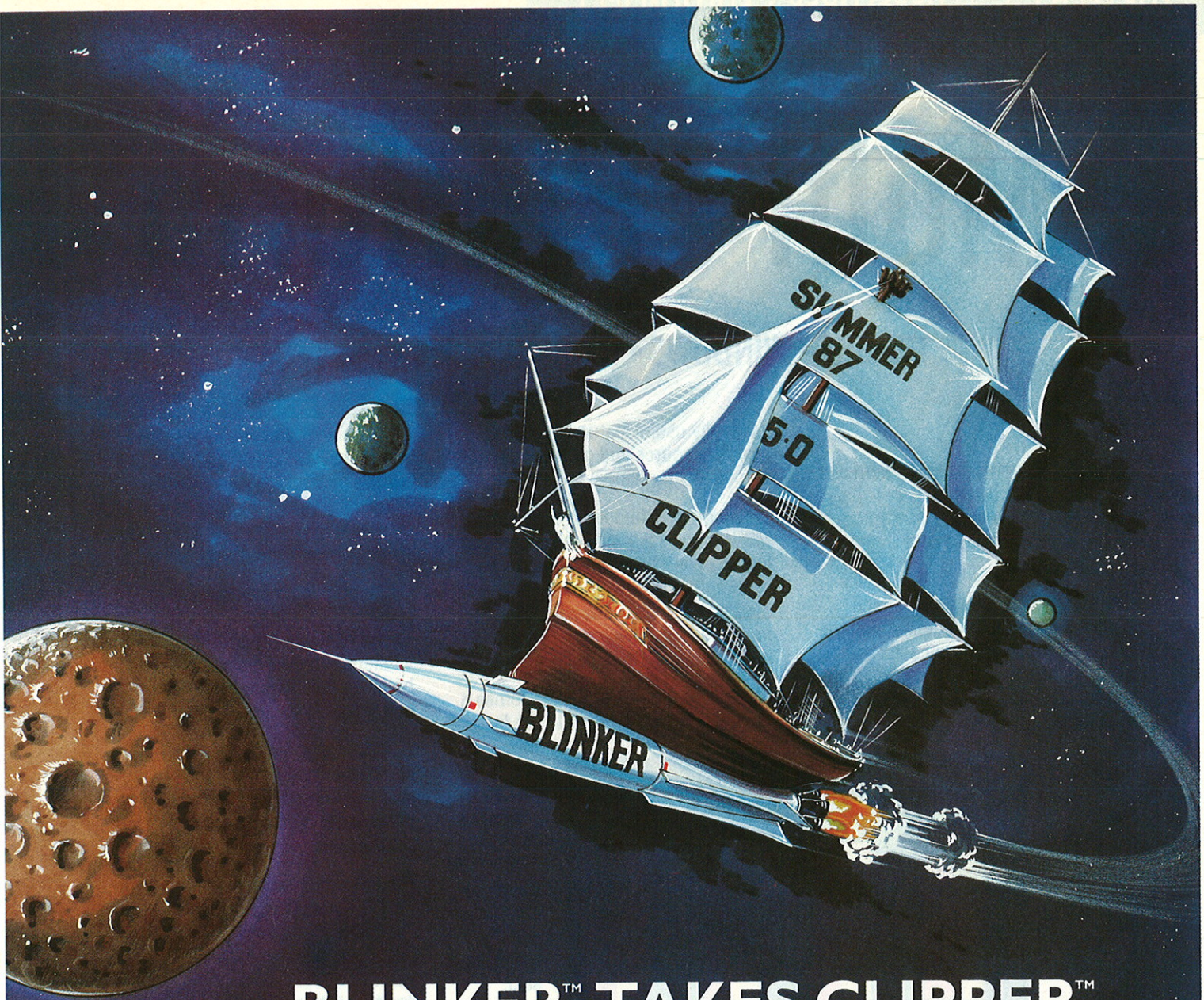


Figure 7 - The Turbo Vision object hierarchy

Paul G Smith left for a trek through the Nepal Himalaya before he could finish this article. Back in the UK he is a software developer, consultant, and writer specialising in graphics, communications and OOP techniques. He can be contacted on AppleLink and CIX as pgsmith.

Will Watts remained behind in Chiswick to finish the article and sulk. He cannot be contacted on AppleLink, CIX or even Telecom Gold.

Turbo Pascal V6.0 has an RRP of £99.95 plus VAT, Turbo Pascal Professional V6.0 costs £199.95 plus VAT. Various upgrade deals are available, starting at around £50. The product is available now.



BLINKER™ TAKES CLIPPER™ OUT OF THIS WORLD

Blinker eliminates the need for complex overlay structures for both Clipper Summer '87 and 5.0

* Significantly reduces run-time memory requirements
* Accelerates your development cycle 3-10 times faster than any other current linker and even faster when linking incrementaly
* Dynamically overlays C and Assembler code sich as Extend.lib, dGE, FUNCky, other Clipper Add-ons and your own 'C' code
* Optimises your application with advanced profiling functions
* Includes memory defragmentation, 'burning-in' of Clipper environmental variables/serial numbers and creation of demonstration versions

IT'S ALL PLAIN SAILING WITH BLINKER

What the experts say

Here are just some comments from the 5000 happy users to date

"It's blinking fast!"

"Congratulations – we gained over 100k"

"It's so good, I went through all my programs and re-compiled/linked just for the pleasure of seeing all the free memory"

"It's fast! Handles overlays like a dream"

"Amazing – No more messing about with overlay structures!"

"Brilliant!... But my coffee breaks have been shortened!"

"Actually exceeded our most optimistic performance hopes! (Just for once)"

European sales and support:

QBS Software Limited
10 Barley Mow Passage, Chiswick, London W4 4PH
Telephone 081-994 4842. Fax 081-994 3441. BBS 081-747 1979

Authors and publishers:

Blink Inc Limited
Raglan House, Llantarnam Park,
Cwmbran NP44 3AB

All trademarks recognised

CIRCLE NO. 393

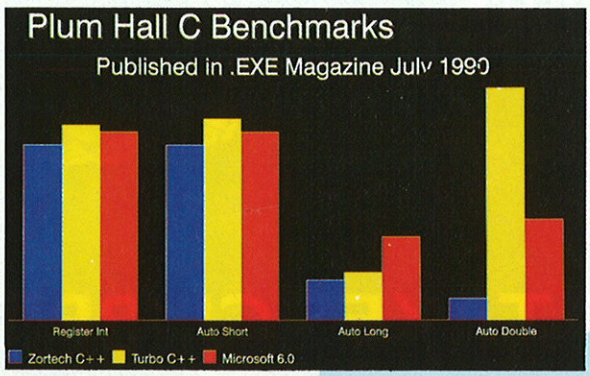
Multi - Platform

MS-DOS • WINDOWS • OS/2 • DOS 386 • UNIX 386

MS-DOS

Zortech's industrial strength compiler provides all the benefits of C++, but with the speed and code size you would expect from the best C compilers.

The quality of the original Zortech C++ implementation together with the continuous improvement achieved since its launch in June 1988 produces fabulous benchmarks. Just look how far it's ahead of the nearest competitor.



Zortech C++ provides state of the art, USEFUL features, most of which are added in direct response to customer requests.

You can effortlessly cruise through the DOS 640K barrier using Zortech's Virtual Code Manager (VCM™). This allows you to develop applications up to 4MB in size whilst in real mode, without changing your C/C++ source code. Zortech's much acclaimed 'handle pointers' provide an elegant solution to processing EMS memory.

Zortech C++ also uses the Rational Systems™ DOS Extenders allowing you to easily compile and debug really large programs, even large MS-Windows 3.0 applications. If you want to purchase a Rational Systems license for your own applications, your Zortech code is Plug & Go.

Zortech's new C++ Workbench provides a cross platform development environment for C++. It has really useful features including powerful source and grep browsers, to look at your handiwork.

In response to hundreds of requests, MS-Windows 2.1 support was added into the base DOS C++ Compiler in version 2.0. Now with Zortech C++ V2.1 development of C++ applications for Windows 3.0 is a reality not a promise.

Along with the C++ compiler comes a top quality ANSI C compiler. In fact, after reviewing 14 C/C++ compilers in its May 1990 issue, Computer Language editor J. D. Hilderbrant said:

"The pressure to name an overall winner in the compiler sweepstakes is nearly overwhelming...it's an easy choice. We pick Zortech!"

Thousands of our customers had existing C code they wanted to recompile, so we made it simple. In the words of BYTE Magazine:

"I fed a Microsoft C specific version of the Micro-EMACS editor source to Zortech's compiler, and less than one hour later, I had a new (and smaller) program."

Our C++ Debugger, which understands C and Assembler too, is CodeView™ compatible, but that's where the similarities end. This feature packed tool can examine your program from 19 viewpoints and uses overlapping windows with full mouse support, icons and dialog boxes.

Debugging large programs is no problem with our DOS Extender, Virtual and Remote debugger versions. Quite simply, there's no better C++ debugger to use and no better C++ to debug.

Our C++ Tools package is the most comprehensive set available. All 25 class libraries are extensively documented and come with the full source code.

The Zortech C++ Developer's Edition V2.1 includes C and C++ Compilers, C++ Debugger, C++ Tools and the FULL Library Source Code (excluding Flash Graphics). That's right, you don't have to pay hundreds of dollars extra for source code - it's in the box!

MS-WINDOWS

Improved support for MS-Windows (including new Windows 3.0 support) is provided in the base C++ DOS compiler, at no extra cost. With Zortech, you can now even compile from within Windows!

Support for new extended keywords _loadds and _export as well as the ability to create DLL's make programming in Windows with C++ practical. We provide extensive documentation and 50K of sample code to illustrate development of

ZORTECH Inc., 4-C Gill Street, WOBURN MA 01801 Tel: 617-937-0696 Fax: 617-937-0793 Orders: 1-800-848-8408
ZORTECH Ltd., 58-60 Beresford Street, LONDON SE18 6BG Tel: +44-81-316-7777 Fax: +44-81-316-4138

Zortech C++

MS-DOS • WINDOWS • OS/2 • DOS 386 • UNIX 386

applications in this exciting new environment. Do you need MS-Windows class libraries? Call for details of third party Zortech Validated Products.

OS/2 NEW

The OS/2 Developer's Edition now provides a C++ Compiler and source level Debugger designed for C++. In the words of OS/2 Magazine:

"Zortech C++ serves as a direct replacement for the Microsoft C Compiler in developing applications, allowing programmers to use object-oriented techniques in OS/2 development."

The OS/2 Developer's Edition also includes C++ Tools, Flash Graphics and C++ Workbench for OS/2 together with the standard DOS Developer's Edition.

Upgrades for existing OS/2 Compiler Option owners now available. Please call for details.

UNIX 386 NEW

Not a day passes at Zortech HQ without numerous requests for a UNIX version of Zortech C++. Now, DOS and OS/2 developer's can reach new markets by easily moving their code to SCO UNIX 386 and binary compatibles.

ZORTECH
V2.1
UNIX 386 EDITION

The Zortech C++ V2.1 UNIX 386 Compiler generates the same tight, fast code that Zortech's DOS and OS/2 users have come to expect. UNIX specific versions of Flash Graphics and the C++ Workbench are also provided.

In line with the traditional Zortech Policy, owners of the Zortech C++ V2.1 UNIX 386 Compiler will be able to inexpensively upgrade to the forthcoming Zortech C++ V2.1 UNIX 386 Developer's Edition.

DOS 386 NEW

Now, with the 386 you can address up to 4 Gigabytes of memory. Why spend so much money on 386 hardware and not use software which will take advantage of it?

On the other hand, you need to retain the facilities of standard MS-DOS too.

MS-DOS developers can now build true 32 bit C and C++ applications for 386 processors using Zortech's powerful 386 development system. The Zortech C++ V2.1 Developer's Edition for DOS 386, contains 32 bit versions of the C and C++ Compiler, Flash Graphics library, C++ Debugger and full standard library source code together with all the familiar features provided with the standard DOS Developer's Edition.

Using Phar Lapp's much acclaimed 386/DOS Extender Technology, you can build applications which access 4 Gigabytes of linearly addressable memory. Your applications will also be Plug & Go for use with Phar Lapp's 386 DOS Extender which may be purchased seperately.

C++ VIDEO COURSE

Zortech's C++ Video Course is all the training material you need to move a team of good C programmers into the world of C++. Many corporations have already done just this.

Cut the hotel bills, travel expenses and fees of outside training courses and seminars - not to mention the inconvenience and disruption to your normal routine.

Use a proven training tool, that in one hour a day, over a period of six weeks, can train your whole team in C++ for the price of one airline ticket.

The course consists of 32 tutorials on six one hour VHS tapes together with one 256 page workbook containing course notes and exercises. Unlimited additional course workbooks are available at modest cost. Compiler & hardware independent. NTSC or PAL format available.

C++ at Work '90

The new Zortech C++ platforms will be officially released in New Jersey during C++ at Work '90 Sept 24-26, 1990.

CIRCLE NO. 394

PANEL® *Plus* II

Screen Generator and User Interface Library for 'C'

PANEL *Plus* II *features:* Interactive screen design editor • C and MS-FORTRAN code generators • library of user-interface functions • pop-up fields/windows • multi-line fields • mouse support • scrolling regions/ scroll bars • help boxes • pull-down menus • custom validation • shadow borders • complete **library source**, with low-level source and headers for all supported systems (DOS, OS/2, Unix, VMS) • interfaces to popular PC **graphics libraries** • OS/2 DLL • **no royalties.**

Also available: **Utility Source Option** which allows **PANEL *Plus* II** to be ported to any suitable development platform. *New in version 2.1:* **CUA/SAA** compatible key assignments and edit functions, CUA 'function key area' support, word-wrap editing, new menu styles, **MS-C 6.0** interface (with on-line help), DOS-extender interfaces.

Panel *Plus* II licence fee per programmer: **£295** (including library source and 700-page manual). With utility source option: £720. Please call for quantity pricing, full version list, and free demo disk.

Roundhill Computer Systems Limited

Orchard House, Ogbourne St. George, Marlborough, Wiltshire SN8 1SU
Telephone: **0672 84 535** • Fax: 0672 84 525

Roundhill also supplies compilers and development tools from Copia International, Graphic Software Systems, Lattice, Periscope, Pocket Soft, Polytron/Sage and others. Please call for a full catalogue and price list.

CIRCLE NO. 395

'I am not Spock...'

If developers of real time systems thought more about their designs, they might drastically reconsider their choice of processor, says Jon Moseley.

Increasingly, it's a digital world. The bits are on their triumphal march, with computers and their binary tyranny everywhere. The world of control is no exception; most modern systems are computer controlled by anything from a humble PLC to a huge central mainframe, while virtually all loop controllers (PID types etc) are now microprocessor based.

However, there are problems. When microcontrollers were first introduced they were quickly embraced for implementing digital control systems, and devices like the 8051, the Z80 and the 6301 are now ubiquitous. Wonderful as these chips are (the '51 and I have been 'just good friends' for years now) they aren't really suited to real time control applications.

For a start, conventional micro-controllers are just too damn slow. It is not uncommon for micro-controllers to have a clock rate of just a few MHz. For anything but the very simplest control algorithm (eg a counter or an on/off loop) this will be a major constraint - limiting the system to slowly changing environments. An analogue controller built using a couple of op-amps can easily have time constants of under a microsecond - an 8051 will require more than 50 µs to implement even the simplest PID loop. This will restrict it to controlling systems with maximum frequencies of about 2 kHz - that's fine for a central heating system, but not really adequate for an engine management system.

As a corollary to this, the response speeds and latencies of these processors are not always adequate for a real time controller, where the ideal is an instant reaction to a problem. That may never be achievable - but it is clearly true that the faster the response the better!

These processors have some arithmetic and architectural deficiencies when used as controllers too. The most popular chips are all 8-bit devices (the 8051 and its cousins alone claim 40% of the total embedded systems market) - and these can suffer from severe quantisation effects. A resolution of one part in 256 isn't even precise enough to represent 1°, and most applications need more than that. Using a limited dynamic range also introduces truncation and rounding effects - which will manifest themselves as steps or regions of deadband in the response of a control loop. For most real applications, 16 bits internal working is *de rigueur*, even if this will only be used to 8, 10 or 12 bits externally. There can also be problems with overflow - most ALUs warn when there has been an error, but few include hardware (eg saturation registers) to deal with the problem explicitly.

These characteristics have tended to restrict the use of standard, cheap, micro-controllers to the very simplest - slowest - applications. The need for digital control has subsequently led to the development of higher performance processors - the 68000 is very widely used in embedded systems, Intel offers the 8096. But for many applications the same objections apply - these chips are still too slow or too inflexible to cope with the demands of the real time world. So we move on to the current step in the 'Bit race' - the RISC controller.

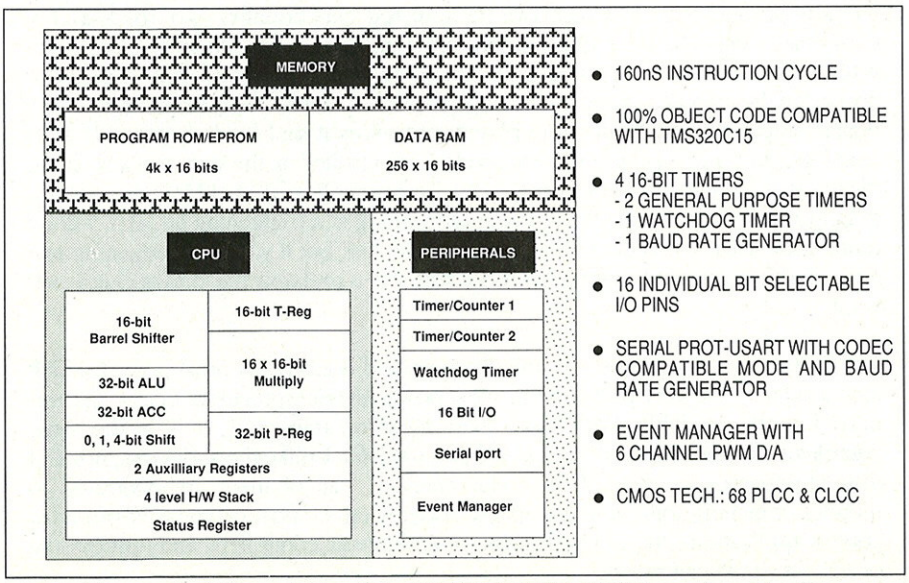


Figure 1 - Key points of the TMS 320C14 DSP based controller

The RISC Red Herring

Increasingly, engineers looking to develop fast real time systems are investigating the use of RISC processors. Devices like the Intel 80960 and the AMD 29000 are being expressly marketed on their suitability to life in an embedded application. These products offer the very latest developments in processor design to allow them to run extremely fast. The central theme of these processors is the basic RISC idea - have a basic core of instructions which are hardwired and run very quickly. However, as well as this, many of these processors employ all manner of clever design tweaks to make them run even faster. For example, the 80960CA (Intel's flagship micro-control-

ler) supports three different pipelines, register scoreboarding, resource scoreboarding and a plethora of cache memories for program, data and registers. This is not a simple chip.

However, for all the complexity, speed and power of these processors, they still aren't well suited to the rigours of a real time system. The single, crucial problem is that they are *unpredictable*- the performance of a RISC processor depends on finding data from its cache memory and on instruction smoothly rippling through the pipeline. On average it may execute one instruction per cycle - but it may not. RISC processors are non-deterministic and, at best, only statistically predictable. That is something to beware of in a real time system, where a late response can be more dangerous than no response.

But RISC processors seem wrongly suited to life as a real time controller just from philosophical grounds. The minimalist reduced instruction set philosophy derives from research done by IBM and Stanford University on the efficiency of instruction sets in conventional minicomputers. These processors have been designed for typical programming tasks; word-processors, compilers, operating systems, accounts packages and the like. These tend to be large programs, with a huge number of subroutines and highly complex structures. They operate on vast realms of data with little regularity or structure - any and all of which may be accessed at a moment's notice, suggesting the need for a dedicated pager or memory management unit. And while they have to run 'as fast as possible', there are rarely any demanding constraints on exactly when an instruction has to be completed.

None of this is the case with a real time controller. These have to operate to very tight deadlines and guarantee a response within a strict time window. Rather than large discursive programs, control algorithms tend to be tightly coded and single-minded in their intensity. Nor do they operate on huge swathes of data - instead they concentrate on a narrowly focused set of inputs, operate on them in a tightly structured way and spew out a well organised set of responses, exactly when and where they are required.

This is a long-winded way of suggesting that RISC processors have been designed for the office micro or scientific workstation and aren't necessarily well-suited to steering a robot arm. Using standard RISC processors to force speed into a real time system, rather than thinking about its real needs, seems a short-sightedly machismo approach ('I've got more MIPS than you'). A real time control system has its own constraints and demands - perhaps it's more rewarding to look for a technique that directly (and efficiently) addresses them.

Similar problems (the need for a fast guaranteed response in a guaranteed time, with relatively simple algorithms and data structures) were encountered by engineers working in the digital communications industry about 10 years ago. Lacking the luxuries of fast modern processors, but still needing speed, these engineers were forced to develop their own architectures. Thus was born the digital signal processor.

Who's Who in DSP

Texas Instruments was the first company to produce a popular DSP device (the TMS320C10) and the company has dominated the field ever since. Like its contemporary, the 8088, the C10 set a standard that others have followed, but it is now essentially obsolete and attention focuses on the newer C25 (fast 32-bit integer device) and C30 (very fast 32-bit floating point) processors. Despite the legacy of an ugly instruction set and constipated architecture these devices are ubiquitous; TI has over 60% of the total DSP market.

The company has just launched the C14, a straightforward and rugged device aimed squarely at the micro-controller market. This is a 16-bit device with four timers on-chip (including a watch-dog and a baud-rate generator), six channels of PWM output and a healthy amount of serial and parallel I/O support (see Figure 1). It is intended for mass-market applications and is being evaluated for a number of systems in the automotive industry.

Analog Devices is most famous for the quality of their op-amps and ADCs, but it also has a range of elegant DSP devices in their catalogue. Their AD2100 is a 16-bit integer-only processor, which is starting to look a little dated - rumours abound that new versions are imminent. This is a nimble chip with an elegant architecture and clean instruction set. It's probably most interesting because of its use in an unusual application - Atari selected it as the heart of its *Hard Drivin'* arcade game, which attempts to simulate a racing car. The chip is used as the number-cruncher to process the 3D trigonometry and polygon transforms required in real time.

The giant telecommunications company AT&T developed two processors for its own, in-house, use. The DSP16 is a 16-bit device, the DSP32 is a 32-bit floating point chip. The DSP16 is blindingly fast - with an instruction time of just 25 ns. The DSP32 is no slouch either, with a sustained performance of 25 MFLOPS.

Motorola entered the DSP battle late - giving its designers the chance to take their time and get things right. This it seems to have done. The 56000 is its integer processor. Intriguingly, it's a 24-bit device - the logic for this is that this allows for extended precision internally without the expense of a full 32-bit width (for similar reasons the two ALUs are 56-bits wide). It uses a dual Harvard architecture, with two parallel memory spaces, both of which can be accessed concurrently - say for X and Y coordinates, or the Real and Imaginary components of complex numbers. This device is the *de facto* standard for audio applications; Motorola has got a lovely demonstration using the chip as a stereo 10-channel graphic equaliser. The processor takes the digital output directly from a CD player, processes it and feeds it (via a D to A converter) into a power op-amp. The levels are controlled on the screen of a PC using the mouse. There is a rumour (reported by *Electronics Weekly*) that Motorola is about to launch a 16-bit version of this processor running at a frightening 80 MHz. I don't quite know what you'd do with a processor that fast, but if you're investigating real time adaptive control of a multi-axis robot arm, this is probably the kind of chip you'd want.

The 96002 was only released in July this year, and is easily the most powerful DSP chip available. It is very probably the most powerful microprocessor of any description currently available. With more than a million transistors, it is in the same complexity league as the 68040, the 486 and the i860. Unlike those devices, none of those transistors are wasted on cache memory - all of them are dedicated to number-crunching ability and raw speed. Too powerful (and too expensive) for most control applications, this device is ideal for multimedia controllers, array-processing or serious signal processing.

TOOLBOX WINTER '91 NOW AVAILABLE

ASSEMBLERS

386 ASM Link & Locate	£550
Microsoft MASM v.5.1	£89
OPTASM	£85
Turbo Debugger & Tools	£99

BASIC

Mircosoft BASIC PDS 7.1	£270
BASIC Interpreter	£215
Microsoft Quick Basic	£60
True Basic	£65
Power Basic	£89

C

Lattice C Compiler v.6.01	£170
Microsoft C v.6.0	£250
Watcom C v.8.0	£255
C-terp	£195
C86 Plus	£325
Express C	£65
High C-286	£385
High C-386	£585
Instant C	£310
Instant C/16M	£515
NDP C	£385
Quick C	£60
Quick C & Assembler	£125

C++

Borland C++	£129
Borland C++ Professional	£195
Guidelines C++ with book	£275
Intek C++ 80386	£320
Zortech C++ Compiler v.2.1	£120
Zortech C++ Dev. Edition	£270

COBOL

acucobol MS-DOS	£900
acucobol Net-Bios	£1250
acucobol XENIX-286	£1500
acucobol UNIX-386	£2000
acucobol *OTHERS*	CALL
Microsoft COBOL v.4.0 *NEW*	£585
Real Menu	£210
RealCICS	£750
Realia COBOL	£750
RM/Cobol-85	£750

dBASE

Clipper Version 5.0	£325
DB Fast/PLUS	£255
DB Fast/WINDOWS	£255
dBASE III Plus	£395
dBASE IV	£515
dBMAN V	£190
dBXL Diamond	£165
dBXL/Lan	£389
Foxbase+ v.2.10	£255
Foxbase+/386	£385
Foxbase+/LAN	£385
Foxbase+ Runtime	£445
Foxbase+ SCO XENIX	£495
Quicksilver Diamond	£389

DATABASE MANAGEMENT

Advanced Revelation	£615
AskSam	£190
Clarion Personal Developer	£195
Clarion Professional	£545
Informix 4GL	£645
Informix 4GL for Xenic	£900
Opus One	£255
Oracle for 1-2-3	£195
Paradox 3.5	£595
PFS Professional File	£165
R:BASE Ext. Report Writer	£190
R:BASE for OS/2	£579
R:BASE for DOS	£445
Reflex	£89

FORTRAN

Microsoft Fortran v.5.0	£250
Fortran-F77L	£385
NDP FORTRAN-386	£385
ProFortran	£235
RM/Fortran	£385
SVS Fortran	£435

OTHER LANGUAGES

ACTOR	£450
ACTOR Language Extension	£65
CCSM Mumps Single User	£65
PC Logo	£65
RPG II Complete	£1035
Smalltalk/V	£65
Smalltalk/V 286	£129
Snobol 4+	£65
Toolbook	£299
Trilogy	£65

PASCAL

Microsoft Pascal	£170
Oregon Pascal-2	£149
ProPascal	£235
Metaware Professional Pascal	£579
Metaware Prof. Pascal 286	£385
Turbo Pascal v.5.5 with objects	£89
Turbo Pascal Professional	£159

PROLOG

Arity Combination Pack	£710
Expert System Dev. pack	£190
Intelligence Compiler	£299
MicroPROLOG Professional	£645
MProlog	£299
Professional Prolog II Plus	£899
Professional Prolog	£545
Prolog Advanced Toolkit	£99
Prolog Compiler	£129
Prolog Compiler/Interpreter	£420
Prolog-86 Plus	£165
SQL Development Pack	£190
Turbo Prolog	£65

AI AND OBJECT ORIENTED

C-Talk	£99
C+ Objects Vol 1 with Source	£275
CxPERT	£515

CASE TOOLS

Easycase Plus	£190
Visible Analyst	£385
Visible Analyst Workbench	£1535
Visible Dictionary	£385
Visible Prototyper	£385
Visible Rules	£385

COMMUNICATIONS LIBRARIES

AdComm	£190
C ASYNCH MANAGER	£125
Communications Library	£195
Comm Pak with Breakout	£195
Multi Comm	£89
Net Lib	£129
NET-TOOLS	£95
SilverComm	£125
Comm Plus	£65
Turbo ASYNCH PLUS	£125

FILE MANAGEMENT

B-Tree	£65
B+Tree for C	£55
AXOS	£255
Btrieve OS/2	£370
Btrieve Multitasking	£370
Btrieve for DOS v.5.1	£395
Btrieve XENIX	£370
C Index+	£255
c-tree	£255
Faircom Toolbox Professional	£710
Code Base 4 v.4.2 DOS & OS/2	£190
Code Base 4 UNIX/XENIX	£319
db_FILE/RETRIEVE	£190
d-tree	£320
dBC III	£165
dBC III Plus	£330
RealDL/I	£645
WKS Library	£129

GENERAL

C Tools Plus	£99
C Utility	£165
C*Lib C Function Library	£120
DB/RA3	£125
dBase Program Utility	£55
dBase Program Utility Vol 2	£55
dBase Tools For C	£55
Functions with source	£149
Integrated Dev. Libraries	£99
Pascal Toolkit	£85
Pascal Tools 1	£75
QuickPak Professional	£99
Quick Tools Library	£79
Spindrift Library	£99
Spontaneous Assembly	£255
Super Functions	£195
Tom Rettig Help Combo	£79
Tom Rettig Library	£65
Turbo C TOOLS	£99
Turbo Plus	£129
Turbo PowerTools Plus	£99
Turbo Functions	£69

GRAPHICS

dBase Tools for C Graphic	£55
dGE v.4.0	£190
EGA Toolkit	£165
Essential Graphics	£259
Flipper	£129
FontWINDOW/Plus	£170
GEOGRAPH Professional	£210
Grafmatic CGA & EGA	£135
GraphiC	£255
GSS Graphics Dev. Toolkit	£399
GSS Kernel	£385
GSS Metafile Interpreter	£225
HALO-88	£255
HOOPS Extended DOS	£515
MetaWINDOW/Plus	£210
scLASERplus	£299
SilverPaint	£65
SilverPak	£179
Slate	£195
Universal Graphics Library	£130

OP. SYSTEM ENHANCEMENTS

DESQview API C Lib/Ref	£129
Multi C	£89
Multi Dos Plus w/source	£65
OS/2 Programmer's Toolkit	£215
OS/286	£320
OS/386	£320
Resident C	£65
Time Slicer	£190
VMFM	£115
Wendin PC UNIX	£60
Wendin PC VMS	£60
Microsoft Windows v.3.0	£95
Microsoft Windows S.D.K v.3.0	£325

QUERY

CBTREE/SQL	£255
CQL Query System	£265
dQUERY/Lib	£179
db_RETRIEVE	£239
XQL	£480
Xtrieve PLUS	£395
Netware SQL	£385

REPORT

CB/IQ Report	£139
Coreports	£179
Focus Report Writer	£210
r-tree	£179
R&R Relational Reportwriter	£95
R&R Clipper Module	£49

TEXT SCREENS

Animator COBOL	£120
Application Manager	£450
C-Worthy v1.2 Forms/CW	£320
C-Worthy v1.2 Forms/CW+Src	£450
Curses	£105
Curses Window Dev. Kit	£75
Data & Windows	£149
DataWindow	£179
dWindows for db3	£60
Face-it	£65
Flash-up w/Toolbox	£85
Forms II	£179
Guido	£165
HI-SCREEN XL	£99
Multi Windows	£179
On-Line Help	£90
PANEL PLUS II	£319
PC Forms	£129
Pop Screen	£59
POWER SCREEN	£99
Pro Screen	£65
SCREENIO	£259
Screen Sculptor	£75
ScreenStar	£65
Screenplay	£115
SoftCode	£65
SoftCode Template	£39
Softscreen/Help Source	£150
Sourcewriter	£645
UI Programmer Dev. Edition	£345
V Screen	£39
VCScreen	£90
Vitamin C	£135
VLib with Source	£90
Vermont Views	£245
Z View	£149

DEBUGGERS & DISASSEMBLERS

386 Debug	£125
Breakout-II	£79
D'Scope 2	£159
dBug for dBase	£125
DIS*DOC	£79
Periscope II	£110
Periscope II-X	£90
Periscope III	£875
Periscope I Rev 3	£435
Periscope IV (16 MHz)	£1245
Periscope IV (20 MHz)	£1435
Periscope IV (25 MHz)	£1625
Plus Board with 512K	£310
Plus Board with 0K	£220
Serial Test	£310
Soft Probe II/TX	£245
Soft-X-plore	£79
Sourcer/BIOS Pre-Proc. *NEW*	£110

DOCUMENTORS

ASM Flow	£69
C-Clearly	£95
Clear+ for dBASE	£129
Clear+ for C	£129
dAction	£55
dAnalyst	£190
dFLOW	£89
Documenter	£190
Flow Charting III	£149
Tree Diagrammer	£65

EDITORS

BRIEF v.3.0	£159
BRIEF v.3.0 *UPGRADE*	£60
BRIEF OS/2	£159
dBRIEF v3.0 *NEW*	£79
BRIEF with dBRIEF	£229
C-EDIT	£255
EMACS	£210
Epsilon	£129
ME Editor with C Source	£125
Norton Editor	£49
Personal Rexx	£99
PI Editor	£129
SPF/PC	£159
Vedit+	£120

HELP GUIDES AND TRAINING

dBASE on-line	£65
Norton Guides for ASM	£85
Norton Guides for BASIC	£85
Norton Guides for C	£69
Norton Guides for OS/2	£89
Norton Guides for Pascal	£85
Programmer's Library	£255

LINKERS & LIBRARIANS

ALINK *NEW*	£129
Archive Link	£239
Link & Locate ++	£255
LinkLoc	£315
PLINK86 Plus *Now Polytron*	£495
PolyLibrarian II	£125
.RTLink	£190

MAKE UTILITIES

PolyMake v.3.2	£205
MKS Make	£99
MKS Make 5 User	£320
MKS Make 10 User	£515

PROFILERS & OPTIMISERS

Codesifter	£79
DOSTRACE	£65
PC Metric	£129

PROTOTYPERS & GENERATORS

Automated Programmer	£320
Cogen	£290
COMPEDITOR	£130
Dan Bricklin Demo II	£129
Data Boss for Pascal	£395
Genifer	£255
Instant Replay III	£99
Sycero db (U.K.)	£595
Sycero db Net (U.K.)	£745

SYNTAX ANALYSERS & LINTS

PC Lint v.4.0	£90
Pre-C	£150

TEXT & UNIX TOOLS

C Programmers Comb.	£75
C ToolSet	£65
MKS LEX & YACC	£165
MKS Toolkit v.3.1 *NEW*	£165
MKS Toolkit v.3.1 *UPGRADE*	£50
MKS AWK	£65
PC Fortran Tools	£99
QPARSER Plus	£195
Spellcode	£65
Turbo Professional	£85

TRANSLATORS

BAS_C Commercial	£320
Bastoc	£515
dBx dBASE to C v.4.7	£389
dBx Library Source	CALL
dBx UNIX/XENIX Source	CALL
FOR_C v.2.0 MS-DOS *NEW*	£565
FOR_C v.2.0 XENIX *NEW*	£630
FOR_C++ XENIX/386 *NEW*	£1195

VERSION CONTROL

M.K.S. R.C.S.	£125
M.K.S. R.C.S. 5 User	£485
M.K.S. R.C.S. 10 User	£905
PVCS Professional	£395
PVCS Network (5 User)	£1395
PVCS/PolyMake OS/2	CALL

BACKUP - RECOVERY - REPAIR

dSalvage	£65
Fastback Plus	£125
Mace Utilities 1990	£95
Norton Utilities Advanced	£95
PC Tools Deluxe	£85
XTree Net	£255

COMMS. & TERM. EMULATORS

Blast II	£165
Blast II w/Remote Control	£199
Carbon Copy Express	£225
Carbon Copy Plus	£129
Crosstalk Mark 4	£160
Crosstalk XVI	£130
EM4105	£320
Mirror III	£65
PC Anywhere III	£95
Sidetalk II	£79
SmarTerm 125	£190
SmarTerm 220	£129
SmarTerm 2392	£65
SmarTerm 240	£225
SmarTerm 320	£129
SmarTerm 400	£115
SmarTerm 4014	£145
VTek	£125
Z Stem PC-VT100	£65
Z Stem PC-VT220	£99
Z Stem PC-VT240	£190
Z Stem PC-VT4014	£65

DISK MANAGERS &OPTIMISERS

HTest/HFormat	£85
Mace Gold	£99
Norton Utilities Advanced	£95
SpinRite II	£59

OP. SYSTEM UTILITIES

386MAX 5.0	£135
DESQview	£85
DESQview/386	£125
Headroom	£85
Move'Em	£59
Norton Commander	£99
Omni View	£55
Qemm-386	£65
Qemm-50/60	£39
Soft Bytes 386 Max	£45
Weiner Shell	£195
Windows 3	£ 95
X-Tree Pro Gold	£85

FAX OR TELEPHONE CREDIT CARD ORDERS VISA OR ACCESS

PRICING
All prices exclude V.A.T., but include Overnight delivery.

EDUCATIONAL DISCOUNTS
10% Educational discounts available on all products.

CATALOGUE & FACT SHEETS
Call for our new Winter '91 '91 catalogue, over 165 pages of Software Development Tools.

EXE - DECEMBER 1991

THE SOFTWARE CONSTRUCTION CO. LTD.

1 THE MALTINGS, GREEN DRIFT, ROYSTON, HERTS. SG8 5DB (0763) 244114 FAX. (0763) 244025

CIRCLE NO. 396

The Solution

At first glance, control systems and signal processors may seem very different. Control systems deal with the real world (servos, motors, sensors etc) while signal processors deal with waves, pulses and information. In fact, the two systems are amazingly similar. Both are true real time systems, and both behave in a similar way: a standard algorithm operating on a stream of data. Given this similarity, it isn't too surprising that digital signal processors turn out to be very well suited to the role of controllers, and can form the basis of very elegant and efficient implementations of a real time systems.

Incidentally, DSP seems to suffer from an appalling image problem. The name isn't impressive - it sounds like some fringe political party and it has an unenviable reputation for being totally incomprehensible. However, DSP is essentially a very familiar occupation - it's merely the idea of treating signals from the real (analogue) world as digital information, and operating on those numbers to get a result. Simple eh? The idea of using a computer to handle 'real-world' tasks, control processes or analyse data seems so commonplace that it hardly deserves to even have a special acronym!

For those of us who like 'arguments from elegance', there's another reason to look favourably at DSP based controllers. While it seemed philosophically wrong to use RISC processors intended for open workstations in an embedded real time system, there is something aesthetically right about replacing an analogue controller, made with analogue signal processors (amplifiers, filters) with a digital controller made of digital signal processors.

There are a number of different DSP devices available, but the major players in the industry are Texas Instruments, Motorola, Analog Devices and AT&T. They all offer a range of parts intended for different markets and different applications. (The inset box briefly describes some of the more popular ones). However, they all have some features in common:

- They run very, very, very quickly. Even the almost obsolete TMS320C10 has a 25 MHz clock and instruction cycle times of 25 ns are not uncommon. The very latest parts run even faster...
- All of them guarantee one instruction per cycle.
- They are deterministic and wholly predictable.
- They have multiple internal buses and internal DMAs.
- All of them include a fast (single-cycle) hardware multiplier. Most also have at least one dedicated multiply accumulator, which means that the operation A = B * C + D will execute in a single cycle. (The i860 uses a similar architecture.)
- They are designed to apply a single algorithm or operation to a set of data which is in some way regular or structured. For example, in a controller the regularity is that a new input sample is expected every microsecond. In a signal analysis system, the regularity is that there will always be 1024 samples at a time.

u(n) = u(n-1) + k0 * e(n) + k1 * e(n-1) + k2 * e(n-2)

```
;GET NEW SAMPLE
PID     IN    E0,PA0
        MPYK  0          ;CLEAR
;ACC = U(N-1)
        LAC   UN
        LT    E2
        MPY   K2,E1
;ACC = U(N-1) + K2 * E(N-2)
        LTD   K1
        MPY   E0
;ACC = U(N-1) + K1 * E(N-1)
;       + K2 * E(N-2)
        LTD   K0
        MPY
;ACC = U(N-1) + KO * E(N)
;       + K1 * E(N-1) + K2 * E(N-2)
        APAC
        SACH  UN,PA1
OUT
```

Execution time on standard 25 MHz TMS320C10 = 2.24 µs.
c/f National HPC16083 10 µs, Intel 80C196 25 µs

Figure 2 - PID Control loop implemented on TMS320C10

As an example, consider a PID (proportional - integral - derivative) loop - the commonest control structure. This can be implemented either as a conventional (analogue) system or as a discrete (sampled) signal system. Figure 2 then gives the code for the discrete form, written for the TMS320C10 processor. This was the first really popular DSP device, introduced by Texas Instruments about 10 years ago. Despite its age, it will run this algorithm in approximately 2.24 microseconds - slightly less than an Intel 8096 would take to do a single multiply. Despite its speed, this is emphatically not an expensive, luxury device - a catalogue by my desk lists the one-off price as £10, and I've seen a US ad quoting $4 in volume.

Of particular interest to readers of .EXE is software development. DSP processors have traditionally had a reputation for being complicated, hard to use and difficult to program. In the past this might have been deserved; the earliest devices (in particular the TMS320C10 series) had very eccentric architectures (that's being kind) which didn't support pointers or loops. As a result,

Some current control systems based on DSP devices

- ***Disk drives.*** DSP devices are used in control loop to move the head over the disk surface as fast and as accurately as possible. They also implement notch filters to keep things stable and eliminate resonances and vibrations.
- ***Robotics.*** DSP devices are fast enough to cope with the problems of real time control of a multi-axis system - even as it moves. If that doesn't seem difficult, just think how the load and inertia will vary as the arm extends...
- ***Active Suspension.*** Lotus are using TMS320C14s to measure the pitch and roll of a car and control four hydraulic cylinders to counter these loads - forcing the car to behave in an 'ideal' way.
- ***Noise Cancellation.*** By listening to a source and generating the 'anti-noise' signal it is possible to reduce the apparent noise of an engine. Lotus are using Texas TMS320C25s to achieve a reduction of about 10 dB in a typical industrial application.
- ***Engine Management.*** DSP devices monitor engine performance (temperature, pressure, gas content) and vary the control signals (spark timing, fuel/air ratio etc) to get the best possible performance. Since this is an adaptive system (unlike current engine managers) it will cope well with wear, ageing or changing external circumstances.
- ***Non-destructive test.*** By listening to the way a metal part 'twangs' it is possible to detect whether it is flawed or cracked. A system based on a Motorola 56000 is used by Rolls Royce to test their jet engine turbine blades using this technique.

CopyControl

THE NEW GENERATION OF COPY PROTECTION

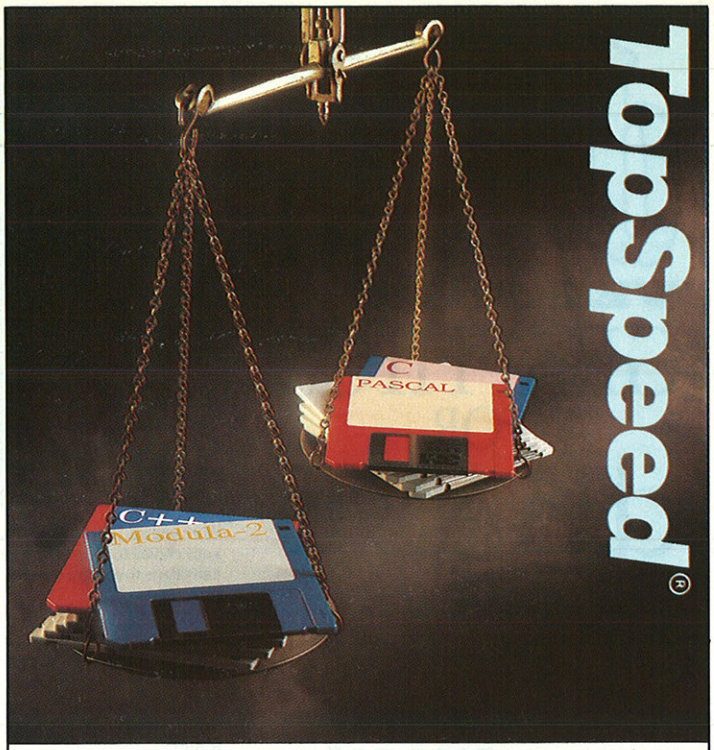
NO	User hassle
NO	Back-up problems
NO	Hardware add-ons or special disks needed
NO	Changes to source code required
YES	CopyControl beats ALL bit-copier Programmers
YES	Floppy disks, hard disks and networks supported
YES	CopyControl is totally transparent to the user
YES	You can limit program use by no. of copies, no. of executions or date
YES	CopyControl works on all IBM compatibles
YES	Free demo disk available

For Further Information Phone or Write to:

microcosm

Microcosm Limited,
17 Cranbrook Road, Bristol BS6 7BL
Telephone: 0272-441230

CIRCLE NO. 397



Are you weighing up the pros & cons of your next choice of language?

Will the language you choose today meet your development needs of tomorrow? How can you save the time and money already invested in past projects? Can you make the most of the skills you have now, and yet still keep up-to-date with developments in programming technology? A fine balancing act by any standards.

DOS or OS/2, a first time user or a professional developer, the choice has never been easier. TopSpeed, from Jensen & Partners International, is a growing family of languages which share the same code generator, linker and run time system, as well as the much acclaimed TopSpeed development environment. All TopSpeed languages simply slot in to form a *true* multi-language programming environment.

Whatever your choice of languages, now or in the future, keep the balance in your favour! Contact JPI on 071 253 4333 or write to Jensen & Partners UK Ltd, The Turnmill, 63 Clerkenwell Road, London EC1M 5NP. Fax: 071 251 1442.

YES! Please keep me updated on the TopSpeed range of languages and compilers. I am interested in:
C ☐ C++ ☐ Pascal ☐ Modula-2 ☐ Other _____

Name: _____ Position _____

Organisation/Company: _____

Address: _____

_____ Postcode: _____

Tel: _____

Jensen & Partners International

EXE•12•90

CIRCLE NO. 399

The world is flat!

The Berlin Wall will never come down!

It is difficult to introduce software into North America!

Well, here goes another world class myth...

OTG Systems, Inc. can help establish your software product in North America. We offer a competent sales and marketing consulting service. If you have tried or have always wanted to introduce your software into the North American marketplace, OTG can provide your organisation with a great opportunity.

OTG Systems, Inc. will work with your budget and provide a comprehensive mix of sales activities, follow-up and support. We will also help you identify additional sales and marketing channels which best suit your software product. We have worked successfully with software firms in the United Kingdom and other parts of Europe.

OTG™
SYSTEMS, INC.

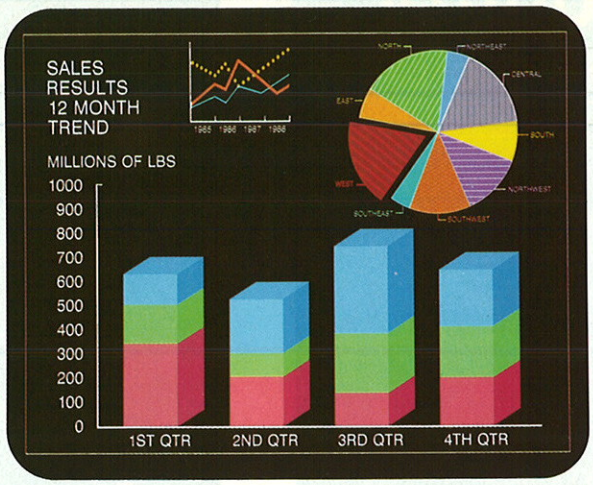
Tele 717.222.9100
FAX 717.222.9103

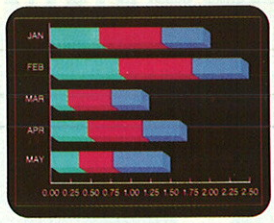
OTG SYSTEMS, INC.
Suite 300
Rts. 106 & 374
Clifford, PA 18413-0239

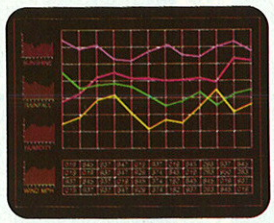
In the 1990's over $40,000,000,000 will be spent on software in North America. Contact OTG Systems now to channel some of those dollars into your organisation.

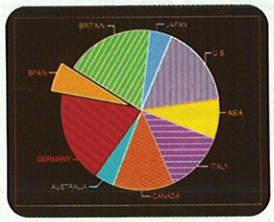
CIRCLE NO. 398

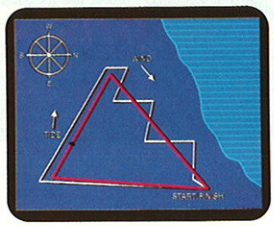
dGE
VERSION 4
GRAPHICS FOR dBASE











dGE extends the database language of your choice to give full colour graphs and charts from **within** your programs.

dGE version 3 was voted the "best graphics tool for the database manager" for the second year running by readers of the influential U.S. magazine DataBased Advisor.

Now Version 4 is here with even more features:

- SuperText with variable sizes and face styles
- SuperIcons loaded from file
- SuperText and SuperIcon editor that can import PCX images
- Built-in Vector Text functions
- Gantt charts
- XOR capability added to many functions
- New interfaces to Clipper 5, FORCE and Vulcan
- Mouse "hot" regions
- A Norton Guide to functions

dGX, the Graphics Design Centre, has been completely revised, adding:

- Sophisticated database query and summary
- Dynamic scaling
- Import of PCX images
- Statistics functions
- Gantt charts, hi-lo and 3-D bars

Version 4 comes complete with all the interfaces to dBASE and its dialects, the 'C' language, R:BASE compiler and Vulcan.

dGE supports CGA, EGA, VGA and Hercules modes and will output images to matrix printers, lasers and plotter.

Call for information.

Price £245 + VAT direct from Bits Per Second Ltd or from your authorised dealer.

dGE IS A TRADEMARK OF BITS PER SECOND LTD. OTHER BRAND AND PRODUCT NAMES ARE TRADEMARKS OF THEIR RESPECTIVE HOLDERS.

BITS PER SECOND

BITS PER SECOND LIMITED
14 REGENT HILL BRIGHTON BN1 3ED
TELEPHONE: 0273 727119
FAX: 0273 731925

CIRCLE NO. 436

I X I

Software & Manuals OSF/MOTIF™* and X™*

UK: 0223 462131
Int'l: +44 223 462131

▶ From the leading supplier of OSF/Motif and X software tools, manuals and books

OSF/Motif Development Kit

A ready-to-run kit for those developing OSF/Motif style applications on SunOS. We provide all the necessary tools and documentation so you can get going fast. Also, as a member of the OSF, we provide superior support.

The software comprises:

Motif Toolkit – a rich widget set, Presentation Manager compatible.

Motif Window Manager – for controlling window layout, also Presentation Manager compatible.

User Interface Language – allows rapid prototyping of a user interface without programming.

OSF™ Member

X11 Release 4

The quick and easy way to purchase the latest release of the X Window System from MIT. 150Mb of source code and user contributed software on 0.25" cartridge tape or 5.25" floppies. Contains servers for most UNIX platforms.

Reference Books and Manuals

Targetted at software developers, our comprehensive range includes the official MIT X11 Release 4 Manual Set (6 Vol), O'Reilly X manuals featuring tutorial works and the latest OSF/Motif Manual Set (6 Vol).

I X I

IXI Limited 62–74 Burleigh Street Cambridge CB1 1OJ · England Tel: +44 223 462131 FAX: +44 223 462132

** OSF/Motif is a trademark of the Open Software Foundation, X is the trademark of MIT.*

I N F O R M A T I O N S E R V I C E S

CIRCLE NO. 400

a) P-code (with loops)

```
Start
        For a = 1 to 100
              b = 2 * a
              c = Func (b)
              Out (c)
        Next i
```

b) Straight line Code

```
Start
              c =Func (2)
              Out (c)
              c = Func (4)
              Out (c)
              c =Func (6)
              Out (c)
              etc
```

Figure 3 - Example of straight line coding

it was much easier to use a macro and copy a piece of code out long hand ('straight line coding') which was confusing to write or debug, and used memory like it was going out of fashion. An example (in pseudo code) is given in Figure 3. In addition, the structure of the assembly language and choice of mnemonics for this processor were beautifully cryptic (see Figure 2).

Development

That is no longer true. Modern DSP chips all support very powerful pointer structures and addressing modes, and most of them have hardware support for loop operations (ie zero-overhead DO loops). It is no accident that the architecture of the Motorola parts is very reminiscent of their siblings, the 68K series - indeed if you're familiar with 68000 code you'd be able to use the 56000 DSP part almost immediately. The AT&T processors use assembly code that will be instantly recognisable and usable by anyone who knows C (not too surprisingly, since the same firm invented both!). Unfortunately, in the interests of compatibility, Texas has had to retain its weird mnemonics - I suppose that's the disadvantage of being first. If it's any compensation, it is by far the largest company in the DSP market (63% share) and has a huge range of products.

But who cares about the assembly language? Have you ever even seen the assembly language of an 80960 or a SPARC processor? Nowadays, the only people who write assembly code for fast processors are the marketing engineers tweaking benchmarks to get the best possible figures to publish in the datasheets. Instead, everyone uses compilers for all but the most time critical sections of a program - and DSP devices are no exception. There are some very good compilers and software support systems available for these processors. Often these come from the manufacturers of the silicon, but an increasing number of third party suppliers are involved too. For example, Intermetrics wrote the (excellent) optimising compiler for the Motorola 96000.

In fact (perhaps as a reaction to this reputation?) there are some extremely impressive tools available to help developers use DSP systems. These include software simulators and emulators, graphical development tools and code-generator packages. Packages like Hypersignal or Comdisco's SPW, which let you work from a block diagram of the system and generate code to implement it, have a power and sophistication that rivals some of the best mainstream 4GLs.

Because so much more computational power is available, a DSP-based system gives engineers the opportunities to use better algorithms than would be possible with a conventional processor. As an example consider an adaptive controller.

Released At COMDEX-90 in LasVegas

PictureBox £149.95

After a successful showing at 'COMDEX-90', Highland Grafix was pleased to announce last week that PictureBox, the perfect low cost Slide-Show presentation software package is now available. Whether you are simply displaying a series of pictures and text to promote a product or giving a complicated public presentation, PictureBox is perfect for all your needs. Included are several utilities for capturing both TEXT and GRAPHIC screens directly into your presentation or for editing.

PC Paintbrush IV Plus

Number One in sales is Zsoft's paint package. This has been bundled to provide complete scanner support for the import of your presentation material. In addition you can edit your images and overlay text. Full support for PCX, PCC and TIFF has been included to interface with your favourite DTP package. PictureBox supports almost all printers and plotters including colour and laser printers.

Special Effects F/X

PictureBox understands the need for your presentation to be more than just a series of slow slide exposures. Incorporated in this has been a complete series of special effects that you can use. For example, why JUST DISPLAY your company logo when you can instead Slide, Wipe, Crush, Drip, Diagonal, Spiral, Random and many more. In addition you can select the direction of the effect, Up, Down, Left, Right, In, Out and to any corner on your screen. Control the picture speed and the delays for accurate timing of your presentation to within 1 second.

Flexibility

PictureBox offers a full graphical user's interface (GUI) for the ease of use and can even support touch screens. The only limitation with PictureBox is your imagination. PictureBox has set down new standards for presentation. Simple to use graphic menus will make the learning curve very short and you will be able to use PictureBox in just a few minutes after you have completed the installation.

FREE Runtime

Incorporated with PictureBox is a royalty free run-time module that you can give away with your custom presentation.

At last a real Slide-Show package has come of age, and is available .

More Slots For AMSTRAD

Add more slots to your Amstrad or any other portable computer that has only a single expansion socket. Our "Expansion Box" will expand your portable computer to have three (3) additional sockets.

Easy to install, just plug the "Expansion Box" into your portable and add those much needed cards into the "Expansion Box". Your portable will now have all the expandability that a normal desktop machine would offer you. "Expansion Box" will support both 8 and 16 bit add-on cards.

Introductory Price £ 299.95

Pinna Electronics Ltd., APL Centre, Stevenston, Ayrshire KA20 3LR
Tel: (0294) 605296 or Fax: (0294) 68286

CIRCLE NO. 401

A problem with a conventional PID design (whether implemented with an analogue or digital controller) is that its parameters are fixed. If the process changes in any way after initial installation, then the controller will no longer be performing to its best ability and, clearly, the system's closed loop performance is bound to deteriorate. Many processes exhibit behaviour that changes with time; consider the build-up of scale in a heat exchanger, the deterioration in burner condition in a furnace or the variation between different batches of raw materials.

One answer to the above problems is to use a controller that can adapt to changing situations and automatically adjust itself to cope. Essentially, it looks at the behaviour of the system and tries to analyse how it is changing, to ensure that the controller is always running at its optimum performance. This could be done in a heuristic (rule-based) way, perhaps using an expert system, but an alternative is to use mathematical techniques to 'Solve' the system and find the new control parameters (in much the same way that linear regression allows us to find the function relating points on a graph - but varying with time and in N dimensions!). Unfortunately, this requires a stupidly large amount of processing power, which has traditionally limited them to controlling very slow systems. For example, a typical adaptive control system running on a 386/387 combination might have a maximum sampling rate of perhaps 100Hz; limiting it to system frequencies of well below 10Hz. Analogue Devices supply an application note for their AD2100 processor which describes a similar system ('Stochastic Gradient Adaptive Filter') running with a sampling rate of 8 kHz - 80 times faster.

Conclusion

Like an actor who has performed a famous role and has become type-cast ('I am not Spock - I am a serious actor'), DSP has become pigeonholed as a communications or military technology. This is unfortunate; any system that's primarily doing repetitive numerical work - such as a digital controller - should consider using a DSP device to good effect; either on its own or as a coprocessor. If you're considering a design that requires several processors to do a lot of number crunching, then it's a virtual certainty that a DSP-based solution will be more appropriate, more efficient and probably cheaper too!

EXE

Jon Moseley was a hardware engineer until he sold his soul and traded soldering iron for a typewriter. Hobbies include sinking jet-skis.

Clipper Developers

It's time to get

FUNCky

Dirk Lesko's FUNCky library gives you high performance features to develop more powerful Clipper applications. FUNCky supports data-driven technology like no other library. With FUNCky you can create dynamic applications which are easier to use and easier to maintain. Now afileread() and afilewrite() arrays to text files, quickly flocate() a string in a text file, use maxdbfview() to emulate dbedit() with mouseable scroll bars and resizable windows.

Dynamic Power

Look & Feel

Create applications with the look & feel of the future today. Mouse driven applications with drop-down menus and fast pop-up screens make your programs look great and your users happy. Your programs can have features only possible with a FUNCky imagination.

#1

Rave Reviews

1990 DATA BASED ADVISOR Readers Choice Award

"FUNCky is a breakthrough. It's user interface and mouse functions are the most powerful we've ever seen."
Mike Schinkel, V.P. DSW Group, Ltd.,
Authors of Nantucket's authorized training materials.

"On the Straley scale of excellence, where 10 is the best...it's a 10+ for FUNCky!"
Stephen J. Straley, author of "Programming in Clipper"

The FUTURE is FUNCky

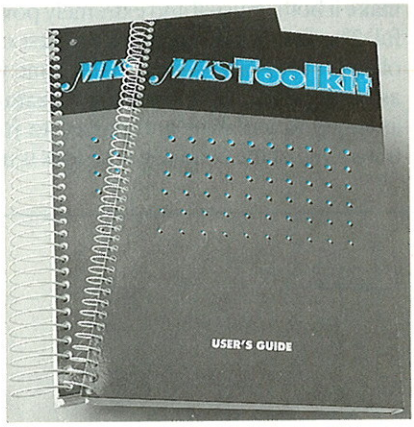
FUNCky is not just another add-on library, it's a new way of doing things. FUNCky has all the functionality of the other libraries and more. More speed, more power, more functions and more flexibility. Complete with a 400 page manual, Tom Rettig's HELP, Norton Guides files, and tons of example code to get you started. FUNCky, fully optimised for both Clipper Summer '87 and Clipper 5.0. FUNCky will be on sale in Nov 1990. For a free demo disc, sales and support contact European distributors :-
QBS Software Limited Tel: +44 81 994 4842,
Fax:+44 81 994 3441, BBS:+44 81 747 1979

Clipper is a registered trademark of Nantucket Corporation. MADvertising © 1990

CIRCLE NO. 402

"The MKS Toolkit is an amazingly faithful replication of a System V UNIX™ environment." – UNIX Review

Essential UNIX Tools for any PC user



"The entire MKS documentation package proved excellent in every respect"

Daniel McAuliffe, IEEE Computer, Jan. 1990

We can tell you that MKS Toolkit offers both experts and novices the purest form of UNIX utilities in a DOS or OS/2 environment. Fortunately, we don't have to. Software reviewers, universities and major corporations all over the world are discovering MKS Software and how it can help their programmers and software developers make the most of their creative talents.

With our proprietary code, MKS Toolkit offers you more than 150 UNIX System V. Release 4 compatible tools for DOS or OS/2. With MKS Toolkit, your computer or clone becomes a comfortable environment for shells, string matching, editing, file manipulation, and more.

In this one package you will receive a complete:

- MKS Vi full – screen editor
- MKS Korn Shell – user programmable interface
- MKS AWK – programming and prototyping language
- profiler – to analyse the execution time of code
- egrep/fgrep – fast pattern matching
- archivers, sort/merge, encryption, data compression & much more

Over 150 commands that help you get the most productivity out of your PC.

Easy Installation

With MKS's menu-driven installation you can be up and running in less than 10 minutes, no matter what your level of computer expertise.

"MKS software is absolutely the best in its class. Don't mix environments without it."

Grover Righter, Novell

Interconnectivity & Lan Licences

MKS Toolkit interacts well on most standard PC and PS/2 networks. Combined with Novell Netware™, the most popular LAN for PC's, MKS Toolkit creates a UNIX time sharing system in DOS or OS/2 organizations. UNIX workgroups can now hook up all of their PCs using PC-NFS™ and MKS Toolkit, enabling you to use a PC as a UNIX workstation and off-load your mini or main machine.

Spanning Novice to Expert

This versatile software reflects it's users' needs. UNIX experts will have all the familiar power they demand while novices will find our documentation filled with excellent tutorial material.

Organizations such as AT&T, Hewlett-Packard, ITT, and NCR – all heavily committed to the UNIX system – use MKS Toolkit to create a standard operating environment. Universities from King's College to the University of Berlin use MKS Toolkit to enrich personal research computing environments and double the potential of their PC teaching labs.

"With this package, you can become familiar with the UNIX environment on your microcomputer, with DOS only a keystroke away."

Byte Magazine, May 1989

Cost-Effective Learning Tool

If your organization is committed to moving into the UNIX environment, then MKS Toolkit is the perfect learning path. DOS or OS/2 users retain the familiar world of their PC keyboard and programs yet can move to a desktop UNIX environment at a keystroke. Exposure to new commands and functionality now becomes an integral part of the novice's working day.

MKS Programming Platform

MKS Toolkit can be purchased as an individual product or you can buy MKS Programming Platform which contains MKS Toolkit and three other MKS products. MKS Platform helps smooth out the details of programming and software development by adding time-saving utilities such as: MKS RCS (Revision Control system), MKS Make (an automated program builder), MKS LEX & YACC (compiler learning and construction tools).

In all, you simply cannot find a more complete set of commands and utilities to get from DOS or OS/2 to UNIX. Once you have used MKS Toolkit, programming will never be the same again.

US List Price

MKS Toolkit (DOS & OS/2)	$399.00
MKS Toolkit (DOS/2 only)	$349.00
MKS Toolkit (DOS only)	$249.00

Please contact MKS dealers for UK domestic prices.

The Software Construction Co. Ltd. (0763) 244114; fax (0763) 244025
Grey Matter (0364) 53499
Systems Science (071) 833-1022; fax (071) 837-6411

MKS

35 King Street North, Waterloo, Ontario, Canada N2J 2W9

Put The Power Of UNIX In Your PC.

MKS, MKS Make, MKS Toolkit Korn Shell, and MS RCS are trademarks of Mortice Kern Systems Inc. UNIX is a trademark of AT&T.
PC-NFS is a trademark of Sun Microsystems.

CIRCLE NO. 403

(Not a Speech Disorder)

If all you know about LISP is that it's slow, it uses LOTS of brackets and it's favoured by the AI community, then it's time you learned more. Your teachers are Al Roth and John Domingue.

Much has been made recently of Object Oriented Programming (or OOP). C++, we are told, is the shining road to a bright new future. 'Encapsulation, Polymorphism, Inheritance, all these features and more.' But hold on. This isn't new. LISP programmers have been doing this (and much much more) for years. In this article we are going to tell you why LISP is still the language of choice for the cognoscenti. First, some background.

History

The original LISP programming system was implemented at the Massachusetts Institute of Technology based on a paper by John McCarthy, *Recursive Functions of Symbolic Expressions and their Computation by Machine*, published in Communications of the ACM, April 1960. LISP is certainly **not** new. In fact, the authors know of at least one LISP historian! The first dialect that was used widely was LISP 1.5. The LISP 1.5 Programmer's manual (John McCarthy et al) published in 1962 contained most of the basic concepts found in the majority of existing LISP systems, including lists, functions, mapping functions and recursion. The LISP 1.5 Primer (Clark Weissman), published in 1967, added a macro capability.

Twenty years passed. Various object-oriented extensions were made to LISP, developed by various different vendors. It was time to standardise. The ANSI X3J13 committee was formed, with the job of defining a Common LISP standard. X3J13 adopted the first two chapters of the Common LISP Object System (CLOS), with the result that Common LISP now supports a powerful object-oriented programming system.

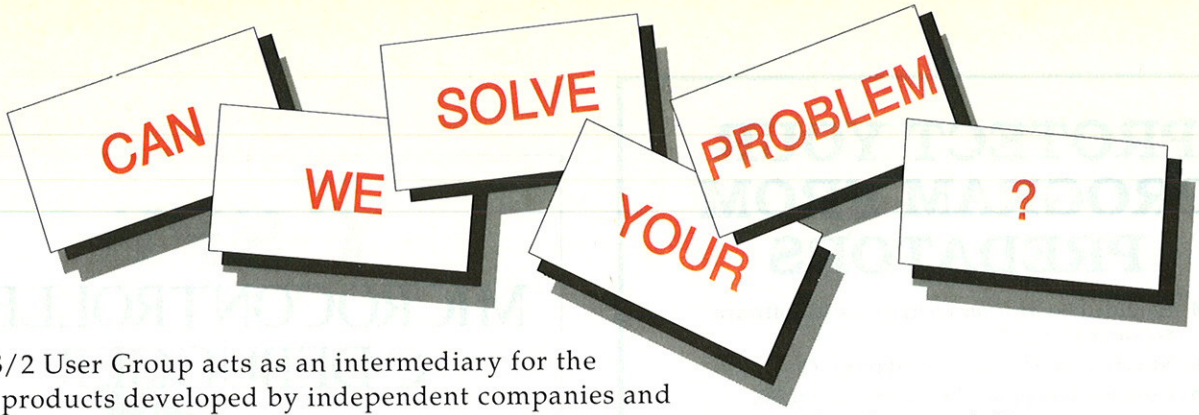
Rudiments

The first thing to do is have a crack at the ubiquitous triangle problem (given to us poor writers as homework by .EXE's Editor). In fact, we have devised two LISP solutions to it, shown in Figures 1 and 2. Figure 1 shows a basic solution, such as might be attempted in an ALGOL derivative. Figure 2 is a more LISPy effort, being based on higher-order constructs. The solution is far more general and there is no hard coding. The program is generic - it could handle shapes like squares and other polygons - not just triangles. This flexibility is a hallmark of LISP.

So that's the homework done, gold stars all round please. But what does the code show? There are some features of LISP that make it both unusual and extremely powerful. The first is that functions are first class objects - they can be used in the same way as other normal data objects, for example, assigned to variables and passed to functions. One of the common ways this is used

```
;;;; Triangle Problem for .EXE in LISP
;;;
;;; This mirrors a conventional language, and avoids using
;;; any of the more esoteric and powerful functions.
;;;
;;; First define a constant for the number of sides in a triangle.


(defconstant sides-per-triangle 3)


;;; The main entry point. Call the function from top level by typing:
;;; "(triangle)".
;;;
;;; (dotimes (index total) (print index))
;;; will print out the numbers from zero up to (not including) total. dotimes
;;; is the simplest and most primitive iteration construct in Common LISP.


(defun triangle ()
  (let ((sides (read-triangle-sides)))
    (format t "~%Triangle entered:")
    (dotimes (side sides-per-triangle)
      (format t " ~D" (aref sides side)))
    (cond ((not (trianglep sides))
           (format t "~%This is not a triangle~%"))
          ((equilateralp sides)
           (format t "~%This is an equilateral triangle~%"))
          ((isoscelesp sides)
           (format t "~%This is an isosceles triangle~%"))
          (t
           (format t "~%Triangle is scalene~%")))))


;;; Read three values and make them into an array. Common LISP guarantees
;;; left-to-right evaluation.


(defun read-triangle-sides ()
  (vector (read) (read) (read)))


;;; Definition of test for valid triangles.


(defun trianglep (sides)
  (not (or (> (aref sides 0) (+ (aref sides 1) (aref sides 2)))
           (> (aref sides 1) (+ (aref sides 0) (aref sides 2)))
           (> (aref sides 2) (+ (aref sides 0) (aref sides 1))))))


;;; Definition of test for equilateral triangles. Note that using prefix
;;; notation for operators means they can take more than two operands, as in
;;; this case with "=".


(defun equilateralp (sides)
  (= (aref sides 0) (aref sides 1) (aref sides 2)))


;;; Definition of test for isosceles triangles.


(defun isoscelesp (sides)
  (or (= (aref sides 0) (aref sides 1))
      (= (aref sides 0) (aref sides 2))
      (= (aref sides 1) (aref sides 2))))
```

Figure 1 - The Triangle Problem, conventional approach



The OS/2 User Group acts as an intermediary for the sale of products developed by independent companies and programmers. There are currently eight software products on sale with substantial discounts to members:-

The Business Graphics Library

A collection of functions in a dynamic link library which may be used in OS/2 Presentation Manager applications to display information pictorially. The library includes a total of over 20 functions including bar charts, line graphs, pie charts, text output, printer, thick line and attribute functions. All the charts will accept any reasonable number of values, and are device independent so may be used to display on a window or print on a printer. The library is supplied as a DLL file together with the header and LIB files required to use it in a C program, a demonstration program, and the source of an example program together with full documentation.

REMDEB

REMDEB is a remote debugger for OS/2 which makes debugging PM programs easier. It can also be used for full-screen OS/2 programs. It works by running REMDEB on one machine and your usual debugger on another. It runs across a LAN thus avoiding the transfer bottle-neck of a serial line.

Dualboot

The DUALBOOT system provides a dual boot mechanism for IBM OS/2 1.1, either Standard or Extended Edition, and PC-DOS 3.3. This can provide the user with a choice of which operating system to boot. However, unlike other dual boot systems, DUALBOOT allows the user to instruct the system (by running a utility) to boot a chosen operating system all the time. The booted operating system can be changed simply, again by running a utility, or the normal option operation can be reverted to in the same way.

Disk Daemon/2

Disk Daemon/2 is a new and powerful OS/2 full screen sector and file editor for the PC and PS/2 family. It allows the user to view or edit both absolute sectors and the contents of PC files with up to 3 files being opened for editing at the same time.

Snoop/2

Snoop/2 allows the developer to view the status of various internal OS/2 structures. It uses a device driver to acquire its knowledge, and can therefore be used on any OS/2 system. It also allows you to view and edit any location in memory, while running programs and dynamic link libraries. (Family Application).

Disa

A User-friendly dis-assembler that allows the developer to view their programs after they have been compiled and linked. Files supported are: .exe, .dll, and .sys files. (Family Application).

Kill-By-Name

A kill-by-name program allowing you to stop - kill - programs by name. (Family Application).

Harness

Harness enables you to debug device drivers using Codeview. It allows you to single step and set break points inside installed device drivers. Initially written as a DOS application, Harness also works with OS/2 installed device drivers.

	User Group Members	*Non-Members*
Business Graphics Library	£75.00	£95.00
REMDEB	£75.00	£95.00
Dualboot	£30.00	£50.00
Disk Daemon/2	£30.00	£50.00
Snoop/2	£150.00	£190.00
Disa	£150.00	£190.00
Kill-By-Name	£40.00	£60.00
Harness	£75.00	£85.00

NAME: _____

ADDRESS: _____

_____

_____

TEL NO: _____

MEMBERSHIP NO: _____

Cheque enclosed for £_____+VAT

ACCESS ☐ VISA ☐ EXPIRY DATE ☐☐☐☐

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐ Please send further information about membership.

NUMBER REQUIRED	PRODUCT	PRICE INC. VAT

OS/2 User Group

International OS/2 User Group, Cecily Hill Castle, Cirencester, Gloucestershire. GL7 2EF England.

Telephone : (Intl +44) 0285 655888 Fax: (Intl +44) 0285 650537

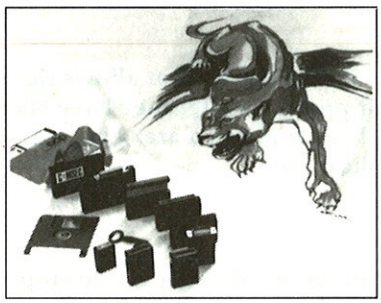
CIRCLE NO. 404

PROTECT YOUR PROGRAM FROM PREDATORS

- Established for over eight years in software security products
- Internationally established product
- Competitively priced keys (from £18.00)
- Supports IBM PC/XT/AT and PS/2
- Supports Apple Macintosh range
- Advanced manufacturing techniques
- Transparent and user friendly
- No drivers necessary (with exception of programmable key)
- Large range of security keys.

For further information and 60 day evaluation kit, contact:

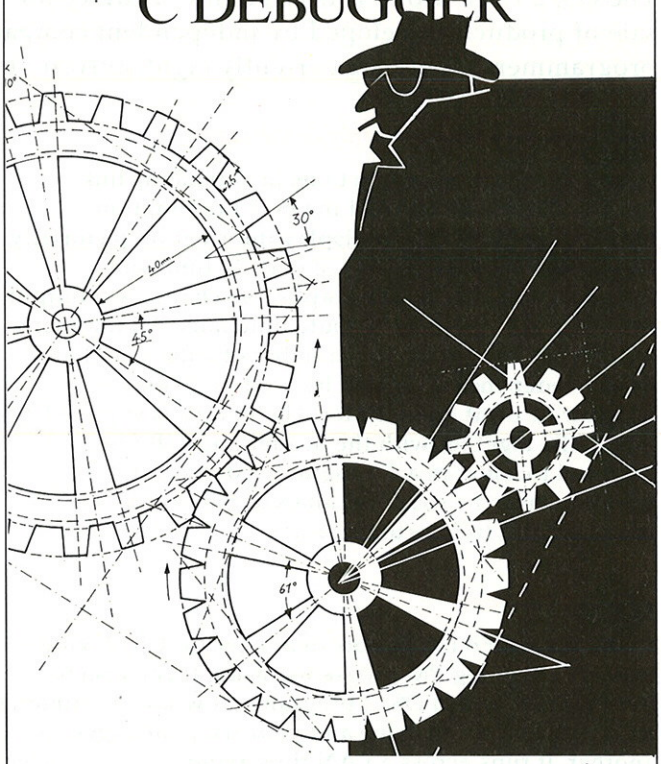
COMSEC (U.K.) LTD.
Cranfield Airport,
Cranfield,
Bedfordshire,
MK43 0AL
Tel: (0234) 751203
FAX: (0234) 751082



COMSEC
(U.K.) LIMITED
COMPUTER & COMMUNICATIONS SECURITY SYSTEMS

CIRCLE NO. 428

C-SPY MICROCONTROLLER C DEBUGGER



8051
68hc11
80C 196
64180
Z80
H8/500
6301

C-SPY DEBUGGER 2.0

The microcontroller C debugger now available in simulator and emulator versions.

- available for most microcontrollers 8051 . 68hc11 . 80C196 . 64180 . H8/500
- standard window based interface
- debug in C and/or Assembler
- advanced breakpoint logic
- full type recognition
- auto and register variables
- function trace and log file
- single-step and auto-step
- extremely fast simulator version

CALL TODAY FOR FREE DEMODISK

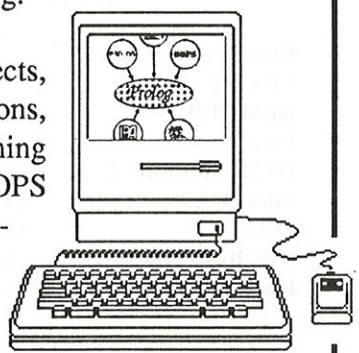
IAR SYSTEMS

IAR SYSTEMS Garden Studios, 11-15 Betterton Street, London WC2E 9BP.
Telephone: 071 379 0344 Fax: 071 240 6093

CIRCLE NO. 405

OOPS + AI -> Prolog++

Now you can combine the best features of AI and OOPS with LPA's new Prolog++, the all new object-oriented extension to Prolog.



Prolog++ integrates objects, methods, messages, functions, attributes - in short, everything you would expect in an OOPS environment - with the declarative power of Prolog.

All of the standard features of LPA Prolog, such as source level debugging, incremental compilation, sophisticated graphics and windows, and so on, are inherited by Prolog++.

So why not be objective, and give us a call?

Logic Programming Associates Ltd
Studio 4, RVPB, Trinity Road, London, SW18 3SX, England
Phone: 081 871 2016
Fax: 081 874 0449

386 Version now available

CIRCLE NO. 429

```
;;; Triangle Problem LISP style
;;;
;;; Note only one function in this version actually knows about
;;; triangles. Demo with (polygon 'triangle)


;;; To extend write a new function say quadrilateral
;;; and insert the name into the assoc list below,
;;; (quadrilateral . 4)
;;; a function should take one argument a list of the sides
;;; in the polygon and return t if the sides
;;; satisfy the appropriate constraints and nil
;;; otherwise.


(defvar *polygon-number-of-sides*
        '((triangle . 3)))
;;; to be added (quadrilateral . 4) (pentagon . 5)))


(defun polygon (polygon-name)
  (if (know-polygon-name? polygon-name)
      (process-polygon polygon-name)
      (apologize polygon-name)))


(defun process-polygon (polygon-name)
  (let ((sides (read-sides (number-of-sides polygon-name) polygon-name)))
    (when (passes-polygon-test polygon-name sides)
      (polygon-checks sides polygon-name))))

(defun know-polygon-name? (polygon-name)
  (number-of-sides polygon-name))


(defun number-of-sides (polygon-name)
  (cdr (assoc polygon-name *polygon-number-of-sides*)))


(defun apologize (polygon-name)
  (format t "~%Sorry, I do not know of the polygon ~a" polygon-name))


(defun passes-polygon-test (polygon-name sides)
  (let ((test-result (funcall polygon-name sides)))
    (format t "~%This is~:[ not~;~] a ~a" test-result polygon-name)
    test-result))



;;;I've assumed that the checks below are for all polygons
;;;if you disagree then put them back into triangle
(defun polygon-checks (sides name)
  (format t "~%This is a ~a ~a~%" (polygon-type sides) name))


(defun polygon-type (sides)
  (or (equilateral-type sides)
      (isosceles-type sides)
      'scalene))


(defun read-sides (number-of-sides name)
  (let ((sides nil))
    (format t "~%Enter the ~a sides of the ~a: " number-of-sides
            name)
    (dotimes (i number-of-sides)
      (push (read) sides))
    (format t "~%~a sides entered:~{ ~D~}." number-of-sides (reverse sides))
    sides))



;;; Both equilateral and isosceles tests use remove-duplicates, which
;;; coalesces duplicate elements in a vector. If all elements are the same,
;;; the length of the result will be one. If two are the same, it will be one
;;; less than the length of the original vector.


(defun equilateral-type (sides)
  (when (equilateralp sides)
    'equilateral))


(defun isosceles-type (sides)
  (when (isosceles sides)
    'isosceles))


(defun equilateralp (sides)
  (= 1 (length (remove-duplicates sides))))


(defun isoscelesp (sides)
  (= (1- (length sides))
     (length (remove-duplicates sides))))


;;; The triangle functions. This is the ONLY function that knows
;;; about triangles.
;;; Definition of test for valid triangles. First get the total length, and
;;; check if any side is greater than half of it. reduce combines all the
;;; elements in a vector, using a function. "(reduce #'+ sides)" returns the
;;; sum of all elements in "sides".


(defun triangle (sides)
  (let ((half-length (/ (reduce #'+ sides) 2)))
    (notany #'(lambda (side)
                (> side half-length))
            sides)))
```

Figure 2 - The Triangle Problem, LISP style

is to replace iteration. It's easy to see why. This piece of code declares a function, `increment-list`, which accepts a list parameter and returns the list with each element incremented:

```
(defun increment-list (list)
  (let ((new-list nil))
    (dotimes (i (length list))
      (push (1+
             (elt list i))
            new-list))
    (reverse new-list)))
```

This piece of code does the same job:

```
(defun increment-list (list)
  (mapcar '1+  list))
```

`mapcar` is one of the set of mapping functions. It applies a function (in this case `1+` increment) to each element in a given list. Mapping functions such as `mapcar` rely on the fact that a function can be passed as an argument in the same way as normal data. This allows the programmer to write code at a more abstract level, a technique which underlies the second version of the Triangle Problem solution.

This point about being able to write code at a more abstract or generic level is an important one - LISP allows you to develop very generic solutions. Prof Gerry Sussman (MIT AI Lab) once said, 'If you are given a problem to solve, write a solution that solves the CLASS of problems you have been given, then write your solution as one of the class'.

OOP in LISP

Let's look at some features of LISP as a language for object oriented programming. Inheritance allows a newly created class to use some or all of the attributes of an existing class. This speeds development (because existing classes can be used to build more complex ones) and economies of storage (characteristics can be stored at the highest place to which they hold true). LISP also offers multiple inheritance, where a class inherits its attributes from more than one parent class. This is a very powerful feature. Certain object hierarchies, if implemented without multiple inheritance, force you to replicate some of the code.

A *generic function* is a function whose behaviour depends on its arguments. In most object oriented languages, the behaviour depends on the first argument. For example, `(move king7)` would exhibit different behaviour from `(move rook3)` if `king7` and `rook3` were instances of classes `king` and `rook` respectively. Flavors and Smalltalk use a message and 'send'. In Flavors notation, `(move king7)` would be expressed as `(send king7 move)`. Generic functions are made up from a collection of methods, each acting on a different class. Each method

specifies the behaviour of a generic function for a particular class. In our example there would be two methods: one for class `king` and one for `rook`.

Methods that are selected on more than one class (or argument) are called *mutimethods*. These are useful when the behaviour of a function is determined by more than one thing. If you were writing a generic function to determine what happened if objects crashed into each other, the result would depend on both objects. A juggernaut - bicycle collision would have a different outcome than a juggernaut - juggernaut collision.

Multimethods provide a neat way to achieve this. They also help you to write programs in the true spirit of OOP: objects do not really have to 'know' about each other. For example, if we add a car as a candidate for catastrophe, we should not have to make changes to either juggernaut or bicycle.

When a message is sent to an object, or a generic function is called, the system must determine exactly which method should be executed. A number of methods may be in contention. *Method combination* is the term used to describe how the competing methods are applied. The simplest example of a type of method combination is that of just using the most specific one. CLOS has three standard other method combinations.

- before - the method is used before existing methods,
- after - the method is used after existing methods, and
- around - the method is used before and after existing methods.

These method combination types allow programmers to add new code with little knowledge of existing code. Suppose a class `robot` exists with the generic function `ask`. `Ask` is called every time the robot wants something. A programmer could create a new class `polite-robot`, by augmenting the generic function `ask`:

```
(declass polite-robot (robot) ())

(defmethod ask :before
          ((x polite-robot))
  (print "excuse me")))

(defmethod ask :after
          ((x polite-robot))
  (print "thank you")))
```

A polite robot would always say 'excuse me' before any request and 'thank you' afterwards. Notice that we have created this new behaviour without any knowledge of how robots were implemented.

Data EQ Program

LISP code and data are both made of the same type: lists. (The name LISP came from **LIS**t **P**rocessing). Program and data equivalence is perhaps the most important feature of LISP, because it helps the construction of programs that create and manipulate other programs. LISP programmers often write programs that can create new functions at run-time. Program data equivalence also allows the programmer to write programs that change themselves, but this is not as frequent. Although it is possible to write Pascal or C programs that manipulate themselves, it is much harder.

Gregor Kiczales, one of the designers of the CLOS, related a useful anecdote at last year's European Conference on the Practical Applications of LISP. The implementation of a window management program (a program which controls the display of a system where multiple windows are present) was greatly simplified, both conceptually and in terms of code quality, when the central data structure which held all the windows (as a stack) was regarded as a program. Kiczales also claimed (and so do we) that this sort of switch between program and data was much more likely to occur when LISP is being used as the implementation language.

It has been noted by Prof Erik Sandewall that LISP is also ideal for implementing special purpose programming languages (SPPL). An SPPL is designed to address a limited application domain, or a specialised function in software. Spreadsheets and database query languages are examples of SPPL that are very popular in the conventional software world. In the field of AI, Sandewall believes that they have been a standard methodology and have embraced ATN parser systems, frame databases, rule-based systems and reason maintenance systems.

LISP v the rest

One clear LISP advantage relates to compiler technology. Incremental compilation is not a feature of most languages. Make a change to a C routine, and you have to recompile the lot. Change a LISP function, you merely evaluate the changed code.

A second general point is that LISP uses dynamic binding. This allows the characteristics of an object to change according to conditions created by the program. Static binding (as in C++) is less flexible, but produces more efficient code.

This trade-off is one that requires careful thought during software development. It has led people to suggest that the price for using LISP is a loss in performance. We do not believe this to be true. In the early days LISP programs were interpreted and so performance was poor. The interpreters were usually written in assembler or conventional high-level languages. More recently, however, LISP compilers have been developed which are themselves written in LISP, an application of the compiler technology of imperative languages such as Pascal. Since the programs themselves are written in LISP data structures, optimisation is easy - easier than with many conventional languages. The final code can be very efficient indeed. The S-1 LISP implementation has achieved comparable performance to FORTRAN running on a Cray.

Since 1985, there has been a standard set of benchmarks for measuring the performance of different LISP implementations. This led to a healthy competition between vendors, although admittedly at the expense of some special optimisation towards the benchmark programs. Today's Common LISP programs are very fast indeed.

Conclusion

LISP has been around for a long time. With the continuing development of such projects as the Common LISP Interface Manager (a generic front-end which will be portable between platforms) and various parallel LISPs (more on these another time, perhaps), LISP surely also has a bright future. LISP offers a mature and robust object oriented programming system which includes features simply not provided anywhere else.

EXE

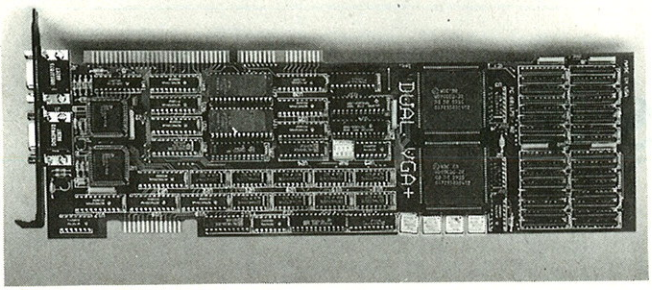
Al Roth is an AI consultant and media specialist. Dr John Domingue is a research fellow at The Human Cognition Research Laboratory at the Open University. Together, with David Lloyd and Dr Tim Rajan, they co-founded EUROPAL - The European Conference on the Practical Applications of LISP.

The authors would like to thank Stuart Watt of Scientia Ltd for his contributions to this article.

EUROPAL '91 will be held March 24th - 27th at Churchill College, Cambridge. Anyone interested in this conference should contact David Lloyd at EUROPAL, PO Box 110, Dorking, Surrey, RH5 4FB, or phone 0306 889 485.

MULTIPLE SCREEN CAPABILITIES USING A SINGLE PC . . .

THE DUAL VGA PLUS



★ UP TO 800×600 RESOLUTION
★ TWO INDEPENDENT SIMULTANEOUS DISPLAYS WITH OVERLAY CAPABILITY.
★ 100% COMPATIBLE WITH IBM VGA/EGA/CGA/MDA VIDEO STANDARDS
★ 4 BOARDS IN ONE SYSTEM GIVE 8 SIMULTANEOUS DISPLAYS

NOW INCLUDES WINDOWS 3.0 DRIVER AND MULTIPLE TERMINAL EMULATION PACKAGE

CEBRA COMMUNICATIONS LIMITED
26 LORNE PARK ROAD, BOURNEMOUTH
TEL 0202 299048 FAX 0202 299192

CIRCLE NO. 406

FORTRAN Testing Blues?-

"WHY DIDN'T MY COMPILER SPOT THAT?"

The cry of despair often uttered after spending days tracking down a bug caused by something simple like the wrong number of arguments in a call.

FORTRAN-lint is a tool that checks subprogram interfaces and eliminates these types of bugs before traditional testing begins.

It can also generate the systems documentation that is so tedious to produce manually.

Join the 450 users worldwide who have eliminated their testing blues by contacting Mark Toole on (0602) 357060, fax (0602) 357064.

Available on VAX, SUN, Apollo and other similar platforms. Evaluation copies available on request.

FORTRAN-lint SPOTS ERRORS COMPILERS MISS

PAFEC
computer solutions

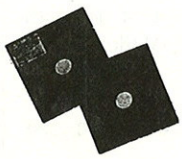
PAFEC Ltd. Strelley Hall Nottingham NG8 6PE Tel. (0602) 357055

CIRCLE NO. 407

BRENT

Communication and Telemetry Consultants

"MaxPro – the ultimate in hardware for software protection"



The MaxPro Data key fitted to the Parallel Port is totally transparent to the end user.

Software customers make as many backups as are required but of course only the machine using the individually coded MaxPro key will run the program.

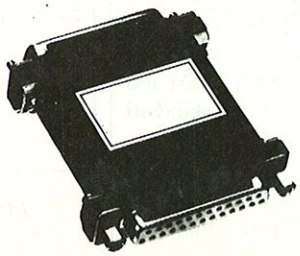
BEWARE THE PIRATE'S PATCH
High security encryption is created by the Simple-to-Use Menu-driven MaxPro attachment software. Other data keys may be patched out in the software rending it totally vulnerable. MAXPRO protected files cannot be patched. Choose whether or not to shut down the program if tampering occurs.

Optional limited life and Usage information collection facilities are provided.

No source or object code modules needed.

The MaxPro system works on IBM; PC; XT; AT Compatibles and PS2.

For additional information contact us at:



Brent Communications
Unit 2
Dragon Industrial Estate
Harrogate HG1 5DN

Tel: (0423) 566972
Fax: (0423) 501442

CIRCLE NO. 408

System Architect™

A PC based Microsoft Windows CASE tool

Microsoft Windows V 3.0 compatible

REALTIME SOFTWARE

118-120 Warwick Street, Leamington Spa, Warks CV32 4QY

TEL: 0926 450858

CIRCLE NO. 409

Windows Stubs

'This program requires Microsoft Windows', and you're thrown back at the MS-DOS prompt. Where is the code that prints this abrupt refusal? Jeff Goldberg explains.

Offset	Contents
0-1	"MZ" for DOS executable
2-1Bh	DOS header
1Ch-3BH	DOS relocation table
3CH-3DH	"NE" for New Executable. Start of Windows header
3EH->>	Rest of Windows header, data tables and code.

Figure 1 - Simplified Windows .EXE Header

Have you ever wondered how Microsoft's Excel or Windows Word started up Windows when run from the DOS prompt? This article will tell you how and provides some sample code.

First take a look at the (simplified) structure of a Windows .EXE header (Figure 1). You'll notice that it starts with the same header as a normal MS-DOS program, albeit with a restricted relocation table. This allows the Windows .EXE file to cheat the MS-DOS loader into thinking it's an MS-DOS .EXE file. A Windows loader would ignore the 'MZ' at the front of the file and search for 'NE' at offset 3Ch into the file. (Incidentally, the 'MZ' comes from the famous Microsoft programmer Mark Zbikowski, who wrote large parts of MS-DOS.)

The upshot of all of this is that the program run at the DOS prompt is a very ordinary, plain vanilla .EXE program. This program is known as the *stub* in Windows terminology, and is defined in the linker definition (.DEF) file. For example, to use the standard stub you create a definition file something like the one shown in Figure 2. The important line is the `STUB 'WINSTUB.EXE'`, which means that WINSTUB.EXE is the program bound into ASCII.EXE to be run in the DOS (rather than the Windows) environment. You cannot, unfortunately, use a .COM file as a stub - the linker doesn't allow it.

```
NAME            ASCII
DESCRIPTION     'Ascii Table'
STUB            'WINSTUB.EXE'
CODE            MOVEABLE
DATA            MOVEABLE MULTIPLE
HEAPSIZE        1024
STACKSIZE       4096
EXPORTS         WndProc
                AboutDlgProc
```

Figure 2 - Example .DEF file

The executing stub lets your program behave like Excel or Windows Word

Our first replacement stub (Figure 3) is pretty well the smallest stub possible. All it does is put out the familiar *This program requires Microsoft Windows* message and terminates. To use it, you should compile and link it, then change the `STUB` command in the appropriate .DEF file. At 568 bytes (using TASM and TLINK) it is 42 bytes smaller than the standard Windows 3 offering.

Some programmers, however, want to generate large programs, to prove that they have done a lot of work. There is no better way of increasing the size of the .EXE file than making a big stub. For example, the executing stub shown in Figure 4 makes a 6 KB file when compiled.

The executing stub lets your program behave like Excel or Windows Word, starting up Windows if run from DOS. It is very simple, merely retrieving the arguments from the command line and using the library function `system()` to call DOS. `system()` uses the path and the current directory to find WIN - if some problem occurs it returns with 1 and sets `errno`. The stub will only execute Windows under MS-DOS V3.0 or above, since earlier versions did not give the program name as an argument to the program. I used Borland's Turbo C++ to compile and link the stub, but it should port to other compilers unaltered.

```
DOSSEG
.MODEL SMALL
.STACK 100h
.CODE


Start:
      push cs
      pop  ds
      mov  ah, 09h
      lea  dx, DosProgramStr
      int  21h


      mov  ax, 4c01h
      int  21h


DosProgramStr:
      db   'This program requires '
      db   'Microsoft Windows'
      db   13,10,'$'


END   Start
```

Figure 3 - The TINYSTUB program

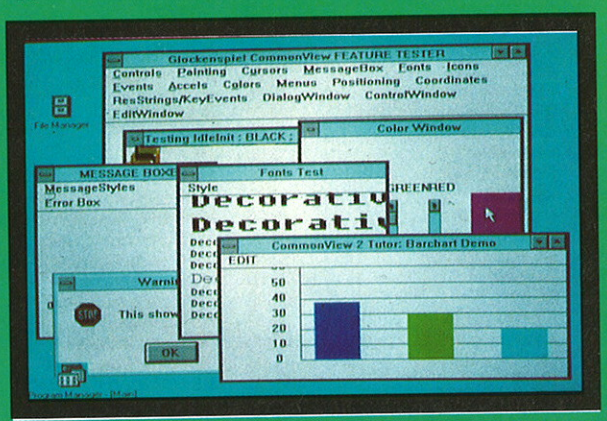
Objects of Desire

glockenspiel CommonView 2

***Glockenspiel CommonView** has really made its mark in the world of Windows development. Thousands of developers have used it to speed up and simplify their projects.*

Now **CommonView 2** is available, inheriting the success of its predecessor and extending its capabilities even further to deliver efficient Windows 3.0 apps.

That's because **CommonView 2** works with **Glockenspiel C++ 2.0**, giving you a C++ object-based framework that reduces the complexity, cuts the code, manages memory and lets you stay in touch with what you're really doing. From compilation to execution, **CommonView 2** applications are fast and powerful.



CommonView 2 objects model the real world of Windows. And that's just the beginning - from there **CommonView 2** takes you as far as you want to go.

It doesn't anticipate everything. That's where C++ takes over: its inheritance capabilities enable you to extend the **CommonView 2** framework. Just take an existing object and customize it without affecting the original. A few additional lines of code and you could, for example, turn an edit control into a password control. Then reuse it in other applications.

You *don't* have to learn a complete new language, you *can* integrate existing developments; it *is* portable to PM and NewWave; CodeView *can* be used on your C++ source.

The world wants Windows 3.0 apps now! And with **CommonView 2** you can inherit the earth.

Specifications.

Glockenspiel CommonView 2 includes Glockenspiel C++ 2.0 and Container - the object storage framework. It requires Microsoft C 6.0, the Windows SDK and 1.5 meg of memory. You debug C++ source with Microsoft CodeView 3.0. Glockenspiel C++ supports a completely portable memory management system. Glockenspiel CommonView consists of approximately 65 classes.

Comprehensive documentation includes CommonView tutorial and reference manual, Glockenspiel C++ compiler manual and User Guide, C++ syntax and AT&T Library Guide, pullout guide to compiler switches, *plus* "Programming in C++" by Stephen C. Dewhurst and Kathy T. Stark (Prentice Hall).

On-line hypertext documentation for CommonView reference manual and AT&T guides. Tutorial source code also on disk.

Glockenspiel C++ works from within the Programmer's Workbench with the reference guides instantly available from the on-line Advisor, using Microsoft CodeView for debugging.

Glockenspiel CommonView applications are portable between Windows 2.1 and Windows 3.0, PM 1.1 and PM 1.2 with HP New Wave 3.0 version coming soon.

glockenspiel
class constructors

QA

QA Training Limited,
Cecily Hill Castle,
Cirencester, GL7 2EF.
Phone: 0285 655888. Fax: 0285 650537.

CommonView costs £495 + VAT and is available for Windows 3, OS/2 Presentation Manager and HP NewWave.

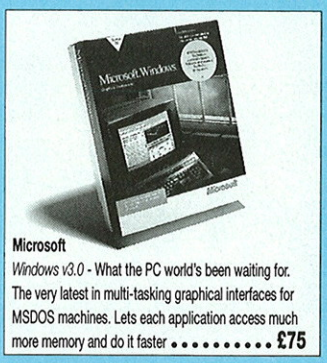
Glockenspiel Professional C++ 2.0 Compilers are available for DOS, OS/2 and Workstation platforms. Call for details.

Glockenspiel CommonView and Glockenspiel C++ are registered trademarks of Glockenspiel Ltd. The trademarks of their respective corporations are acknowledged.

CIRCLE NO. 410

WE GUARANTEE Y
WIDER RANGE OF SO

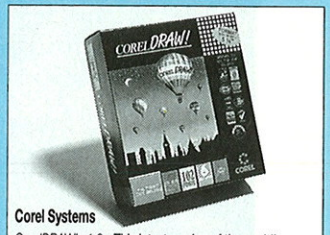
386MAX Professional	79.00
ABC Flowcharter	269.00
Advanced Revelation	595.00
Allways 1-2-3/Symphony	99.00
Alpha Four	375.00
Ami Professional	325.00
Animator	159.00
Arts & Letters Editor	399.00
AskSam	185.00
Asymetrix ToolBook	257.00
ATI/Training Software	59.00
Auto-Might	59.00
AutoCAD Level 10	2395.00
AutoMenu	45.00
Autoroute Plus	112.00
AutoSketch	59.00
Avery LabelPro	87.00
Baler	379.00
Battery Watch	35.00
Bitstream Fonts	135.00
Blast/PC	153.00
Blinker	179.00
Brainmaker Pro	595.00
Brief for DOS	149.00
Brooklyn Bridge	79.00
Calendar Creator Plus	45.00
Carbon Copy+	99.00
Carbon Copy+ AutoPilot	75.00
CheckIt	89.00
Clarion Pro Developer	549.00
Clear Plus/dBASE	149.00
Clipper	325.00
Close-Up/Customer	149.00
Close-Up/Support	183.00
CO/Session	159.00
Colorix VGA Paint	125.00
Concurrent DOS/386	449.00
Control Room	75.00
Copy II PC	27.00
Copywrite	53.00
CorelDRAW!	279.00
Corporate Ladder	69.00
Crosstalk Mark IV	129.00
Crosstalk/Windows	99.00
Cruise Control	37.00
Dan Bricklin's Demo II	159.00
Data Junction Advanced	199.00
Dataease	449.00
DataPerfect	289.00
dBASE III Plus	339.00
dBASE IV/Standard	379.00
dBASE IV/Developer	629.00
dBFast/Windows	149.00
dBrief for Brief	75.00
dBXL Diamond w/R&R	149.00
Deluxe Paint II/Enhanced	79.00
Derive	125.00
DesignCAD/2D	159.00
DesignCAD/3D	229.00
Micrografx Designer	399.00
Micrografx Draw Plus	239.00
DESKpress	229.00
Desklink	95.00
DESQview	79.00
DESQview/386	99.00
dGE Graphics	229.00
Direct Access	57.00
Direct/Net	149.00
Disk Explorer	59.00
Disk Manager	69.00
Disk Technician Advanced	110.00
Documentor	179.00
DOS Partner	69.00
DosUtils	65.00
DR DOS v5	110.00
Dr. Soloman's Toolkit	49.00
Dr. Switch	79.00



Microsoft

Windows v3.0 - What the PC world's been waiting for. The very latest in multi-tasking graphical interfaces for MSDOS machines. Lets each application access much more memory and do it faster **£75**

DrawPerfect	329.00
DS Backup Plus	59.00
dSalvage Professional	149.00
Dynacomm Asynch	279.00
EasyCASE Plus	199.00
Edix	129.00
EXP Scientific W/P	269.00
Fantavision	57.00
Fastback Plus	99.00
Fastlock	47.00
Fastlynx	85.00
Fasttrax	45.00
File Rescue Plus	37.00
Flowcharting 3	149.00
Folio Views	399.00
Fontasy 3 Deluxe	79.00
Force Compiler	439.00
Formworx Publisher/Windows	249.00
Formtool Gold	63.00
Formworx w/Fill & File	99.00
FoxBASE+ S/U	249.00
FoxPRO S/U	425.00
Framework III	339.00
Freedom of the Press	299.00
Funcky Library	149.00
GB/Executive	249.00
GEM Artline	389.00
Generic CADD Level 3	199.00
Generic 3D Drafting	199.00
Genifer III	199.00
Gofer	59.00
GoScript Plus	235.00
Grammatik IV	69.00
Graphics Link Plus	139.00
Grasp w/Artools	97.00
Harvard Graphics	279.00
Harvard Project Manager	495.00
hDC FirstApps	59.00
hDC Windows Express	59.00
Headroom	75.00
Hijaak	79.00
Hot Wire	99.00
Hotshot Graphics	159.00
HyperAccess/5	169.00
Hyperpad	99.00
IBM Current	299.00
IBM Displaywrite	295.00
IBM DOS 3.x	89.00
IBM DOS 4.x	99.00
IBM Fixed Disk Organizer	45.00
IBM OS/2 Standard Edition	239.00
IBM Storyboard Plus	210.00
Impress	115.00
Individual/Training	59.00
Info Select	85.00
Instant Recall	95.00
Instaplan 5000	449.00
Intelligent Backup	93.00
Easyflow	120.00
Kedit	125.00
Kermit for DOS	39.00
KnowledgePRO/Windows	529.00
Language Master	75.00
LANSpool	349.00
Laplink III	89.00
Lattice C Compiler	170.00
Le Menu	53.00



Corel Systems

CorelDRAW! v1.2 - This latest version of the world's leading PC illustration software now comes with even more value; CorelTRACE, 100+ typefaces, over 6 megabytes of clip-art, a Pantone licence - all bundled in for FREE **£279**

Lightning	59.00
LimSim	79.00
Lotus 1-2-3 v2.2	259.00
Lotus 1-2-3 v3	309.00
Lotus 1-2-3/G	550.00
Lotus 1-2-3 for UNIX/386	525.00
Lotus Agenda	229.00
Lotus Freelance Plus	279.00
Lotus Magellan	109.00
Lotus Symphony	415.00
Lucid-3D	79.00
Mace Utilities '90	95.00
Manifest	39.00
MASS Industrial Labeller	269.00
MathCAD	345.00
Mathematica/386 w/387	1195.00
Mavis Beacon Teaches Typing	29.00
Memory Mate	45.00
Menugen	45.00
MenuWorks	35.00
Mirror III	63.00
MKS Toolkit	159.00
Monarch	299.00
Move 'Em	57.00
MS BASIC Compiler	259.00
MS C Compiler	229.00
MS COBOL Compiler	479.00
MS Excel/Windows	259.00
MS Excel for OS/2	299.00
MS Excel/LAN	849.00
MS Flight Simulator	39.00
MS F/S Scenery Disks	19.00
MS FORTRAN Compiler	229.00
MS Macro Assembler	87.00
MS Mouse + Paint	92.00
MS Multiplan	110.00

WE'LL *BEAT* ANY NATIONAL

Software Paradise is an independent software reseller representing more than 2000 manufacturers with over 10,000 software products for IBM Personal Computers (and the Apple Macintosh) running DOS, OS/2 and XENIX/UNIX. We offer **the most comprehensive range of PC software in the world** and have been supplying both users and programmers with quality products and service at the lowest prices since 1986. ***"The Discerning Person's Guide to Software"*** is the most complete Buyer's Guide to PC software available and is published quarterly by Software Paradise. Call us on (0222) 887521 or complete the coupon to receive your *FREE* copy.

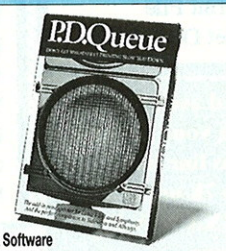
FREEPHONE 0800 378·873
ORDERLINE ONLY

PLACE YOUR ORDERS FREE OF CHARGE FROM ANYWHERE IN THE UK

ALL OTHER ENQUIRIES TEL: (0222) 887521 (10 LINES) FAX: (0222) 862209 (24 HRS)

OU WON'T FIND A FTWARE ANYWHERE*

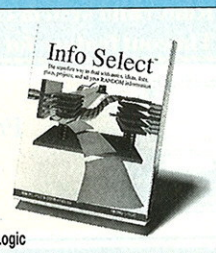
MS Pascal Compiler	159.00	PC-Mix	49.00	QEMM/386 w/Manifest	59.00	Timeworks DTP	85.00
MS Powerpoint/Windows	295.00	PDC PROLOG for DOS	199.00	Qram w/Manifest	57.00	Tornado	59.00
MS Project/Windows	349.00	PerFORM	179.00	Quattro Pro	289.00	Total Recall	79.00
MS Quick C	59.00	Personal Measure	59.00	Quick Schedule Plus	59.00	Turbo C++	129.00
MS Quick Pascal	67.00	Perspective Junior	129.00	Quicksilver Compiler	359.00	Turbo C++ Professional	199.00
MS QuickBASIC	59.00	Pertmaster Advance	1649.00	R&R Report Writer	135.00	Turbo Debugger & Tools	99.00
MS Windows v3	75.00	PFS:First Choice	129.00	R&R Clipper/Fox Module	49.00	Turbo Pascal	79.00
MS Windows SDK	295.00	PFS:First Graphics	129.00	R:Base	375.00	Turbo Pascal Professional	149.00
MS Word 5	259.00	PFS:First Publisher	129.00	Rapidfile	195.00	TurboCAD	129.00
MS Word 5/LAN	849.00	Pixie Graphics	169.00	ReadRight OCR	399.00	Typing Tutor IV Plus	39.00
MS Word/Windows	299.00	Pizazz Plus	79.00	Reflection 4+	225.00	Typografica Prime	49.00
MS Works	99.00	PKZIP/PKUNZIP	54.00	Reflex	179.00	UI Programmer 2	295.00
MSDOS 3.x w/GWBASIC	79.00	PolyMake	110.00	Relay Gold	179.00	UI Touch & Go	235.00
MSDOS 4.x w/GWBASIC	89.00	PolyShell	79.00	Remote 2 Complete	129.00	UltraScript PC Plus	245.00
Multi-Edit Professional	129.00	Popdrop Plus	75.00	RM/FORTRAN	379.00	Ultravision	79.00
Multimate Advantage II	289.00	Power BASIC	69.00	Sage Professional Editor	149.00	Vcache	45.00
Multimate 4	299.00	PowerMenu	69.00	SCO XENIX/386 Complete	1275.00	Ventura Publisher	495.00
Netlib Library	149.00	PreScript Deluxe	299.00	Seemore 1-2-3	65.00	Ventura Pro Extension	269.00
NetUtils	63.00	Primetime Personal	75.00	Service Diagnostics Kit	395.00	Virex-PC	79.00
NeuroShell	139.00	PrintAPlot	179.00	Show Partner F/X	245.00	ViruSafe	79.00
NewsMaster II	59.00	Printcache	95.00	ShowText	149.00	VM/386	145.00
Norton Utilities	49.00	Printmaster Plus	49.00	Sidekick Plus	99.00	Vopt	45.00
Norton Advanced	99.00	PrintQ	89.00	Sidetalk	79.00	Watchdog	185.00
Norton Backup	79.00	Printrite	85.00	Sideways	39.00	Where in Europe	32.00
Norton Commander	79.00			Silvercomm Library	139.00	Who-What-When	139.00
Norton Editor	49.00			SitBack	62.00	Word for Word Pro	99.00
Norton Guides C, OS/2 etc	59.00			SiteLock w/Anti-Virus	329.00	WordPerfect	269.00
NoSquint	45.00			Smalltalk V/286	145.00	WordPerfect Addtn'l Users	149.00
Nutshell Plus	189.00			Smalltalk V/PM	325.00	WordPerfect Library	82.00
OmniPage/386	529.00			Smarterm 320	125.00	Wordstar 2000+	237.00
Opt-Tech SORT	125.00			Smartware II	389.00	Wordstar Pro	205.00
Option Board Deluxe	105.00			Soft Kicker Plus	95.00	Xtree Pro Gold	89.00
Optune	59.00			Soft Type/Windows	129.00	XYwrite III Plus	269.00
OrCAD/SDT	495.00			Software Bridge	85.00	Zortech C	59.00
Org Plus Advanced	85.00			Software Carousel	57.00	Zortech C Video Course	179.00
Overlay() for C/Clipper	72.00			Sourcer/486 w/BIOS	129.00	Zortech C++ Developer	269.00
P.D.Queue for 1-2-3	59.00			SPF/PC	155.00	Zstem-240	199.00
PageGarden	63.00			Spinrite II	69.00		
Pagemaker for DOS	479.00			Sprint	139.00		
Pagemaker/Mac	569.00			SPSS/PC+	599.00		
Paradox 3	375.00			StatGraphics	429.00		
Paradox C Library	295.00			Sterling Accountant Plus	279.00		
Pathminder Plus	79.00			Sterling Financial Controller	379.00		
PC Anywhere	75.00			Super PC-Kwik	53.00		
PC Paintbrush IV Plus	155.00			Superbase 4/Windows	449.00		
PC Tools Deluxe	79.00			Supercalc 5	195.00		
PC Write	79.00			Supercalc 5/LAN	469.00		
PC-Browse	49.00			Superkey	57.00		
PC-File 5	79.00			SuperPrint/Windows	149.00		
PC-Fullbak Plus	69.00			SuperProject Expert	459.00		
PC-Globe	69.00			Switch-It	63.00		
PC-Hookup	79.00			Systat w/Graphics	599.00		
PC-Kwik Power Disk	59.00			System Sleuth	85.00		
PC-Kwik Power Pack	83.00			Timeline	469.00		



Funk Software

P.D.Queue v1.0 - The new add-in print spooler that lets you work in 1-2-3 or Symphony while you're printing. No more waiting around for your printer. The perfect companion to Sideways and Allways **£59**

Procomm Plus	72.00						
Procomm Plus w/Viewdata	107.00						
Professional File	199.00						
Professional Write	199.00						
Professor DOS	52.00						
Project Scheduler	369.00						
Project Workbench	795.00						
Prokey Plus	79.00						
PVCS Professional	379.00						
Q&A	225.00						
QDOS-II	49.00						
QEdit TSR	99.00						



Micro Logic

Info Select v1.0 - The superfast, exciting new way to manage notes, lists, ideas, plans, contacts and all your RANDOM information. Memory-Resident. Easy-to-use yet powerful. Endless uses **£85**

LY ADVERTISED PRICE+

OUR POLICY

- All prices and manufacturer's specifications are subject to change without notice.
- All prices exclude carriage and VAT.
- All orders subject to availability..
- Please specify media size when ordering.
- Goods are not offered on a trial basis.
- Goods are offered for sale subject to our standard conditions of sale which are available on request. E&OE.

* Provide written proof of any U.K mail-order software company who supplies a wider range of IBM PC software than we offer in our catalogue within 14 days of this advertisment and get yourself a FREE copy of PC Tools Deluxe!

+ We are always delighted to be given the opportunity to beat other nationally advertised prices (at the time of placing an order) subject to the same terms and conditions of the company being beaten.

All Trademarks and Registered Trademarks are hereby acknowledged.

SOFTWARE PARADISE

Leading the Way

Software Paradise, Avenue House, King Edward Avenue, Caerphilly, Mid Glamorgan, CF8 1HE

FREEPOST —TODAY—

NO STAMP NEEDED

☐ Please send me my *FREE* copy of ***'The Discerning Person's Guide to Software'***

NAME

COMPANY

ADDRESS

POSTCODE TEL

Post now to: Software Paradise, FREEPOST, Avenue House, King Edward Avenue, Caerphilly, CF8 1ZZ • EXE 12.90

CIRCLE NO. 411

G.W. Computers Inc.
ADCI, 4 Eagle Square,
E.Boston. MA02128
U.S.A.
Tel: 617-569-5990
Fax: 617-567-2981

System-IX (Networks) Ltd.
55, Bedford Court Mansions,
Bedford Avenue, London.
WC1B 3AD U.K.
Tel: 071-636-8210
Fax: 071-255-1038

Menu-iX | System-IX | DBMS-IX | Sysix | AI | Spell | Merge | Lock | GURU | Crypt | Tawk | Tgrep

Cut | More | Term Ctl | Where | Sort | Grep | Idle | CB Trees | Evaluate | Awk | Banner | C Source | Fgrep | Help | Head | Tail

Xenix | Xenix Net | Unix | Interactive | System V | TCP/IP | DOS | Token-Ring | OS/2 | Ethernet | Novell Lan | Mic Net | Aix | VP-IX | VMS | QMS

MenuIX, SysIX & SystemIX under Xenix,Dos & Unix.

Main Options

Administration | Files | Backup | Maintenance | System | Acct | Mail

Ad Options
C Shell
Bourne Shell
Visual Shell
Shutdown
Startup
Install Applic
Remove Applic
Display Process
Display TTY
Modify TTY

File Options
Free Space Maintenance
Create Dir
Remove Dir
List Dir
Print Dir
Create File
Remove File
Print File

Back Options
Backup Files
Backup Filesystem
List Backup
Print Backup
Restore Files
Format Diskette
Copy Diskette

Mnt Options
User
Printer
Invoice Letters

Acct Options
Account User
Account Group
Account TTY
Account All
Enable Account
Disable Account

Mail Options
Phone To User
Send Mail
Read Mail
Write All
UUCP

£49.00

User Options
Create User
Remove User
Create Group
Remove Group
Change Password
Applications

Print Options
Add Printer
Remove Printer
Enable Printer
Disable Printer
Start Schedule
Stop Schedule
Lp Status
Print File
Set Default Lp

App Options
Spreadsheet
Wordprocessor
Database
Other

Db Options
Sys-IX
System-IX
Guru
Csh-IX

UUCP Options
UUCP Setup
Dialcode System
Devices
UUCP Stat
Clear Log
Remove Log

Scrollable-resizable Help

Everthing onscreen is runtime interpreted from your own edited ascii file
Online Hot-Key dynamically scrolls moveable context help from your ascii file
Unlimited chaining through pull-down menues with ITEM status line help
Supports full system and multiple system calls, auto-minimise to 7k under DOS
256 colours, highlight bars, unavailable items. All formats XENIX,UNIX,DOS
Edit ascii file to translate entire runtime to any European language
Runs child system calls and script files. 120 page manual. Unbeatable value
Timeout feature for screen-blank and or password re-entry for networks

Sysix .....From
£99.00 to £295.00

+++ Hardware Systems +++
From 386-16 SX w: 2mb ram/VGA/40mb-dsk £895.00
to 486-25 w: 4mb ram,VGA,.80mb disk £3750.00
call for quotations and latest details & prices.

SCO UNIX / XENIX

	286	386
SCO Xenix Op Sys	£357	£422
SCO Xenix Dev Sys	£357	£455
SCO Xenix Text Pro		£126
SCO Xenix Comp Sys	£775	£905
SCO Unix Op Sys		£525
SCO Unix Devel Sys		£613
SCO CGI Graph Run/Sys	>	£191
SCO Multiview	£256	£321
SCO VP/ix		£321
SCO Foxbase+	£516	£647
SCO Foxbase+ Run/Sys	>	£191
SCO Masterplan	>	£516
M/Soft Word v.5.0	>	£563
Multiplan	>	£321
SCO Eroff Documentor	£451	£516
SCO Lyrix v6.0	>	£386
SCO Professional	>	£386
SCO Image Builder	>	£386
M/soft BASIC compiler	>	£451
M/soft BASIC interp.	>	£256
M/soft FORTRAN comp.	>	£451
M/soft PASCAL comp.	>	£451
SCO XENIX-NET Server	£386	£451
SCO XENIX-NET 3 Server	£841	£1036
SCO TCP/IP (Req streams) Run/Sys		£227

OPEN DESKTOP and XSIGHT also available, £call
Complete systems (runtime/dev) include MENUIX FREE.

INTERACTIVE 386/ix UNIX

New Rel 2.2		Application	Network	Workstation
Platform	(2 User)	£495	£695	£855
	(Multi)	£1095	£1350	£1495
Developer	(2 User)	£1095	£1155	£1295
	(Multi)	£1750	£1815	£1945

These are VERY powerful professional systems, For an Application starter you need about 12-20 mb of hard disk, but a workstation developer needs hard disk space to install 65 by 1.2 or 1.44 mb diskettes. To include things like : Op'sys, Soft'dev (LEX,YACC,SCCS etc), Standard C,NewC Text prc (NROFF,TROFF,TBL,etc), XII, XII Dev, Vpix (DOS SHELL), TCP/IP,NFS, Online MANS, Looking glass, Viewten UI, Codewatch, Co-Edit. Full documentation weighs in at about 40 lbs. All modules can be purchased separately.

Some Parts	1-2 Users	Multi User
386/ix Runtime	£255	£495
Software Development System		£495
X11.3 Runtime	£240	£265
X11.3 Development System	£580	
Multiview		£395
Motif Development System	£365	
TCP/IP		£355
NFS	£355	£420
TCP/IP + NFS	£425	£585
PC Interface, DOS Bridge Module		£365

System kits over £900 include MENUIX, FREE.
System kits over £1500 include SYSIX and GURU FREE.

Utilities/Tools (Unix/Dos) $49.95 each.

G.U.R.U. Combines features of GREP and AWK found under UNIX. Enables exacting searches in records/windows of records, and the results processed / calculated / date-compared / and output formatted in unlimited ways.

SYSED-IX A powerful EMACS split-screen/colour editor that enables extensive customisation to particular user requirements. If you do not like VI, then this editor under Unix/Xenix has its own tutorial and help files making it easier to use.

CSHELL-IX A command processor under DOS that incorporates all the features of the Berkely UNIX C Shell relevant to dos.

Additional HOT Items

Q-Calc spreadsheet	£695
Master-Plan project management	£1295
Uniplex business softwaare	£ 1150
PC-CONNECT	£450
SQL-Connect	£450
PC-TCP	£375
PC-Xview	£245
Xvision	£295
Coherent UNIX	£99
Designer C++	£1195
Terminal Control for UNIX AND DOS	£695
Menuix	£49.95
Sysix	£99.95
Sysix + Guru	£145
System-IX	£295
Sysed-IX	£295
Cshell-IX for DOS	£50

Unusual products : Entire Shakespeare works, Theasaurus & Dictionary, Bibles, 500,000 word lists, Moby Words,CD-ROMS, C sources, Microsoft, Borland, Lotus, Sage and most other well known brands. PLUS CD-ROM and WORM drives, Laser printers, (QMS,HP), and many well known brands

PORTABLE hard disk. FITS A STANDARD 5.25" DRIVE BAY. FRAME & REMOVEABLE DRAWER, takes a 3.5" drive of 40-200 mb into the draw, and remove it in 1 second, Just plug in any O/S of your choice, or take your files from machine to machine. JUST £55

Compaq | Toshiba | IBM | Epson | Qume | NEC | Seagate | Wyse | Relysis | Zenith | Priam | Ranger

CIRCLE NO. 412

```
/* Demonstration of a stub that starts up Windows
   if at the DOS prompt

   Version 1.0 by Jeffrey Goldberg Oct 90

*/

#include  <string.h>
#include  <stdlib.h>
#include  <errno.h>
#include  <stdio.h>

main (int argc, char *argv[])

{
  char CommandBuffer[300];     /* Big enough to satisfy */
  char MSWinName[]="WIN";      /* Current name of Windows */
  int i;

  strcpy(CommandBuffer, MSWinName); /* Copy Win into buffer */
  for (i=0; i<argc; ++i) {     /* Copy command line params */
    strcat(CommandBuffer, " ");
    strcat(CommandBuffer, argv[i]);
    }

if (system(CommandBuffer) == -1) {  /* Problem */
  fputs("Error executing Windows because ",stdout);
  switch (errno) {
    case E2BIG:
      fputs("your argument list is too long.",stdout);
      break;
    case EACCES:
      fputs("MS-DOS denied you access to Windows.",stdout);
      break;
    case EMFILE:
      fputs("MS-DOS has too many open files.",stdout);
      break;
    case ENOENT:
      fputs("Windows is not in the current path.",stdout);
      break;
    case ENOEXEC:
      fputs("of an invalid COMMAND.COM.",stdout);
      break;
    case ENOMEM:
      fputs("of a lack of memory.",stdout);
      break;
  }
  fputs("\n",stdout);
        return 1;
      }
      return 0;
}
```

Figure 4 - A Stub which starts up Windows

These are just two simple (but useful) examples of stubs. If you wish to take this idea to its logical extreme, you should create a stub that contained code equivalent to the Windows program, running under a character version of Windows. Then you would have, at the cost of considerable effort, the equivalent of those dual-mode applications that run under MS-DOS and OS/2... EXE

Jeffrey Goldberg ('cricket' on CIX) has worked on the Psion MC600, Borland's SideKick Plus and SideKick for PM. He is currently looking for his next project...

Accelerate Windows 3.0 Development with WinTrap

What is WinTrap?
WinTrap is a software module that monitors all calls to Windows functions and immediately reports which function has failed if an error occurs.

Who should use WinTrap?
Anyone developing a Windows 3.0 application will benefit from using WinTrap. This includes anyone who cannot readily run CodeView (PS/2 and portable users, and any PC without sufficient RAM). WinTrap can also be used to supplement/replace CodeView to localize errors immediately thus avoiding time consuming rebuilding and tracing.

Why use WinTrap?
The "UNRECOVERABLE APPLICATION ERROR" syndrome costs the average Windows developer about three weeks productivity a year. Scale this by the number of developers on a project and you have the answer. If WinTrap reduces production time by one day, it will have paid for itself.

How easy is it to use WinTrap?
Very. Simply add one line to two of your application build files and you are ready to use WinTrap.

Where can you get hold of WinTrap?
WinTrap costs £99 and is available from:
WinSoft Systems, Martinstown, Kilmallock,
Co. Limerick, Ireland. Telephone: (010 353 63) 88108

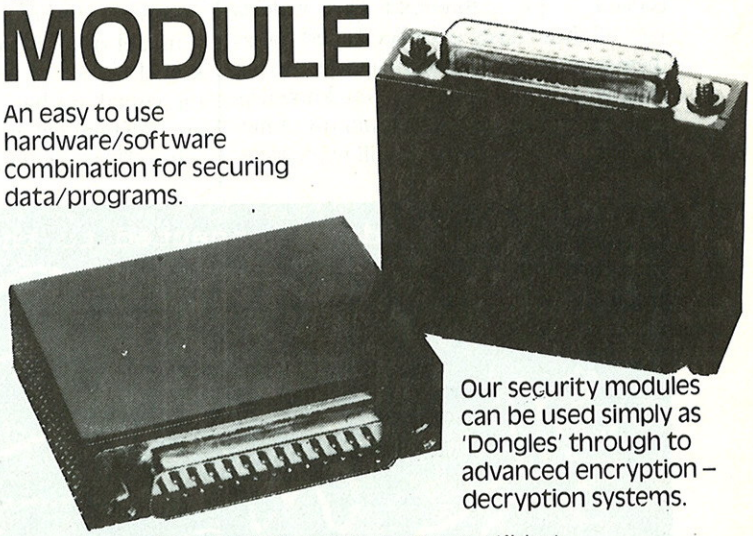
Please state media required. For more information call or write.

WinSoft Systems

CIRCLE NO. 423

SOFTWARE SECURITY MODULE

An easy to use hardware/software combination for securing data/programs.



Our security modules can be used simply as 'Dongles' through to advanced encryption – decryption systems.

- ★ For IBM PC family (and compatibles)
- ★ Variants for other systems
- ★ Advanced construction – rugged and compact
- ★ Proven throughout the world
- ★ Transparent operation – user friendly
- ★ Driver software supplied for variety of applications

CTL

Control Telemetry of London
11 Canfield Place, London NW6 3BT
Tel: 071-328 1155 Fax: 071-328 9149

CIRCLE NO. 424

Dawn Chorus

As UNIX matures, so its kernel becomes obese and overweight. Peter Collinson explains one approach to keeping it small and sprightly.

The sound of letters dropping through the box makes me wander bleary-eyed downstairs. Press releases. Who writes these things? And who do they think they are writing them *for?* Wait a minute, this is interesting... Unisys, a huge American company will be basing its UNIX development on the tiny kernel of a small French company, Chorus systèmes. There is perhaps one technical word of interest in three pages of verbiage, and that word is 'microkernel'. What is microkernel architecture? Why is it interesting?

Kernels

Let's start by looking at the context. The UNIX kernel is the machine resident part of the operating system. It is loaded into the machine at bootstrap time and remains there unchanging until the system is rebooted. Its job is threefold. First, it deals with all those nasty peripherals and forces them to present a consistent interface to the programmer's running program, known as a *process*. Since UNIX is a multi-user timesharing system, the kernel will manage resources ensuring that all processes get a fair share of the machine. Finally, the kernel will provide various hidden services to allow processes to stretch the physical resources of the machine: the kernel will manage virtual memory or swapping.

One day all operating systems will be built this way

The kernel allows the programmer to see a consistent view of the world by presenting a model of a virtual machine. Above the kernel is a set of processes running using the virtual machine model. The processes are independent and are unaware of each other. They communicate with the outside world only using system calls into the kernel.

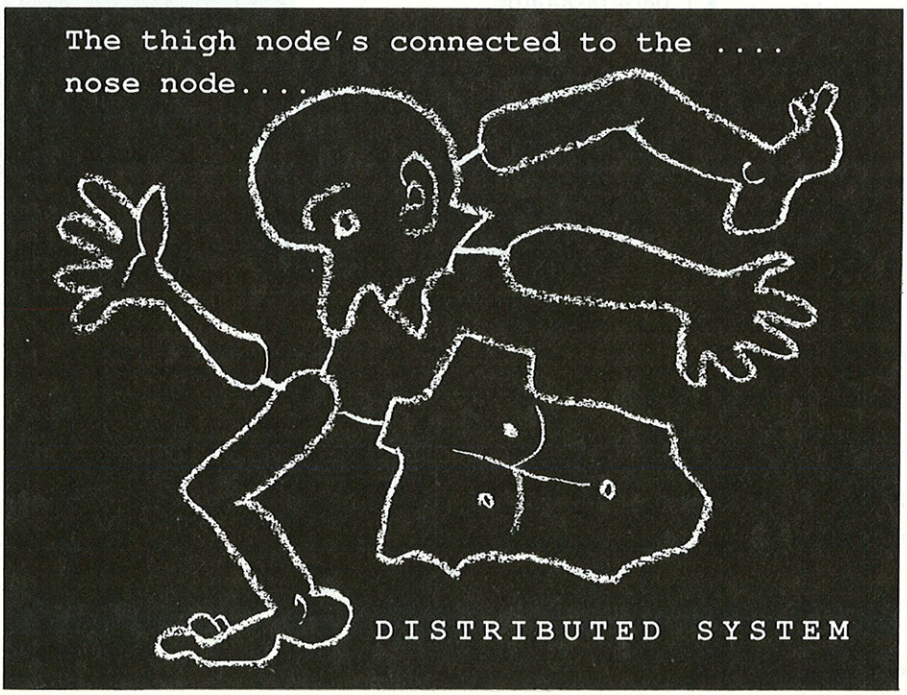
The early kernels were small, constrained by the address space of the PDP-11. Kernels have grown. The kernel size doubled when the folks at Berkeley added the socket mechanism to support TCP/IP in 4.2BSD. The newest release from AT&T, System V release 4, is intended to join all the features of the existing System V releases with many of the features from the BSD world. The idea is to provide a coherent UNIX platform supporting user code from both environments. The result will be a large resident kernel that we will all have to grow to love. In reality, we will complain and grudgingly accept the inevitable because we all need to migrate to a single UNIX software platform.

The large resident kernel has become a 'problem' of UNIX. It will be quite possible for your application to run happily in a UNIX subset where sections of the kernel code will not be touched. In reality, you would prefer to use that memory for your programs.

Well, you say, just don't compile that bit in. That's OK, until I visit your site bringing my favourite program that just happens to use the part of the kernel that you don't have. Worse, you could have bought a system from a helpful vendor who is convinced that some obscure part will never be needed; and all is hunky-dory until you buy the shrink-wrapped box that just happens to need the omitted part. The product just won't run on your so-called *standard* UNIX machine.

So why not have loadable drivers? This is certainly possible, but some things cannot easily be split from the kernel as it stands now - so loadable drivers may not prove to be much of a win.

We have a problem that seems difficult to solve with the existing versions of UNIX. How can Chorus help?



System Science

C & C++ COMPILERS

Microsoft C 6.0	£245.00
Quick C with Quick Asm	£98.00
TopSpeed C ext	£285.00
Turbo C++ Professional	£215.00
Watcom C 8.0 SE	£255.00
Watcom C/386 PE	£815.00
MS Quick C	£65.00

C GRAPHICS

Halo	£225.00
GSS Graphics Dev T'kit	£385.00
GSS XVT Windows	£385.00
Metawindows	£175.00
MS Windows SDK V.3	£325.00
Essential Graphics	£275.00
PCX Programmers Toolkit	£165.00

C DATAFILE

Ctree source	£245.00
Btrieve for DOS	£395.00
XQL	£525.00
CodeBase 4.2	£195.00
db_VISTA III	£545.00

C SCREENS + COMMS

C Scape, Look & Feel	£325.00
Vermont Views (new ver)	£325.00
Panel Plus II	£275.00
Greenleaf Datawindows	£225.00
Aspen Curses (DOS & OS/2)	£115.00
Aspen Formation	£225.00
C Worthy	£call
Blaise C Asynch Manager	£115.00
Greenleaf CommLib	£195.00
Essential Comms	£195.00

PROGRAMMERS TOOLS

C Programmers T'box	£165.00
Photo Finish (demos etc)	£245.00
MKS Toolkit DOS	£155.00
VsDesigner (case)	£475.00
Brief Editor	£149.00
Personal Rexx	£115.00
Kedit Editor	£115.00
PVCS Prof	£475.00
PolyMake	£229.00
MKS Revision Cont Syst	£125

ASSEMBLERS & LINKERS

MS Asm 5.1 & Codeview	£95.00
Advantage Disasm	£145.00
Turbo Debugger V.2	£99.00
RTLink Plus	£345.00
Plink 86+	£315.00
Sourcer & Bios (DisAsm)	£125.00

CROSS DEVELOPMENT

Introl C/Mod-2 68000	£1445.00
Aztec C Cross	£275.00
Avocet AvCase 8051	£795.00
IAR C Cross 8051 etc	£1095.00
2500AD Cross Assemblers	£135.00
IAR Cross Assemblers	£185.00
Simulators & others	£call

FORTRAN

Lahey Fortran F77L	£395.00
Lahey F77L-EM/32 (386)	£895.00
MS Fortran-77 v.5	£245.00
Salford FTN77/386	£695.00
InGraf for Fortran (source)	£175.00
many Fortran Libs	£call

PASCAL, BASIC

Turbo Pascal	£75.00
MS Quick Pascal	£65.00
Object Professional	£95.00
Blaise Power Tools Plus	£89.00
Blaise Asynch Manager	£89.00
MS Basic Prof Dev System	£275.00
MS Quick Basic	£65.00
QuickComm	£95.00
Crescent QuickPak Prof	£129.00
Hammerley ProBas	£135.00

OTHER LANGUAGES

Smalltalk V	£69.00
TopSpeed Modula-2 ver. 2	£145.00
Microsoft Cobol/2	£475.00
PC Logo	£75.00
UR/Forth by LMI	£225.00

MEMORY, DISK & MATHS

386 Max 5.0	£75.00
QEMM/386 5.0	£60.00
QRAM with Manifest	£55.00
Above Disc (LIM Emul)	£69.00
Norton Utilities Advanced	£79.00
SpinRite II	£69.00
MS Windows 3.0	£85.00
Derive Symbolic Algebra	£115.00
MathCad	£345.00
Statgraphics	£545.00
Mathematica	£call

OS/2, UNIX + 386

IBM OS/2 SE 1.2	£250.00
MS OS/2 PM Toolkit	£325.00
SCD Unix 386	£call
Interactive 386/ix	£call
LPI Language	£call
VM-386 multi-user	£call

A SAMPLE OF OUR EXTENSIVE RANGE
PLEASE ENQUIRE FOR UNLISTED ITEMS

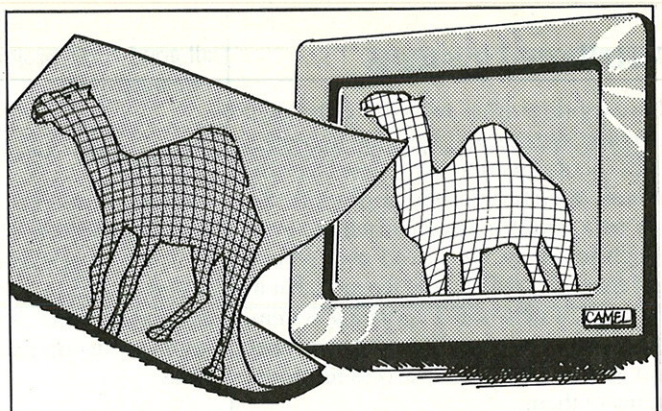
3-5 Cynthia Street,
London N1 9LF
Fax: 071-837 6411

BARCLAYCARD VISA Access

Prices are subject to change and alteration Prices include UK Delivery

071-833 1022

CIRCLE NO. 415



PLOT THE DIFFERENCE

PLOTVIEW

Is the simple, low cost alternative to paper plots. Able to preview plot images on a graphics screen within seconds,

PLOTVIEW allows paperless plotting and replotting – avoiding delays, improving efficiency.

PLOTVIEW

Has up to 25 separate plot files previewable simultaneously on screen and a zoom function which allows any part of the plot to be inspected in detail.

Easy to integrate, PLOTVIEW is ideal for system builders and can be customised to suit their individual needs.

Phone now for more details about PLOTVIEW: the versatile tool that can really make a difference to your productivity.

CAMEL SERVICES LTD.
Telephone OXFORD (0865) 512678

CIRCLE NO. 413

286 Motherboard from £99

286-12	**£99**	**286-16**	**£130**
386sx-16	**£260**	**386-20**	**£430**
386-25	**£470**	**386-33**	**P.O.A.**
486	**P.O.A.**		

Build your own 286-12Mhz from £350, include keyboard, 1M RAM and monitor.

Desktop case+PSU (£100); Keyboard (£45); AT multi I/O card with FDD and IDE controller (£55); monitor (£65); 1.2M Floppy drive (£52).

Options
Tower case (£150); 16 bit 1024x768 16 colour VGA card (£110);
VGA Colour monitor :-640x480 (£230); 1024x768 (£270);
Multisync (£310)

Hard disk 20M (£145); 40M (£190); 100M (£399) and many more.
Floppy drive 1.44M (£45); 1.2M (£52)

DRAM	**256x9**	**£60**	**1Mx9**	**£70**
SIMM	**256x9**	**£60**	**1Mx9**	**£70**

Tel:- 0279 641119 ext 207; Open Mon-Fir 9:00-5:30 Sat by appointment

CACHE SYSTEMS LIMITED

MasterCard VISA

Unit 7, Latton Bush Business Centre, Harlow Essex CM18 7BH

CIRCLE NO. 414

Distributed systems

Chorus springs from work on distributed operating systems and has only become a UNIX platform in recent times. A distributed operating system appears to the user as a single coherent machine, even though resources are spread over several machines. This differs from the more familiar model, a networked operating system, where the user is aware that other machines exist and is able to easily access resources on any of them.

Distributed systems have a big problem: identifying and using resources. When a process wants to read a file, it will eventually call the `read` routine. In a non-distributed system, this becomes a system call which can be thought of as a subroutine call into the kernel. Kernel code is executed and a result copied into the memory of the process. Finally, the `read` call will return, passing some success or failure code to the caller.

In a distributed system, this same `read` call cannot necessarily be executed on the machine where the original process is running. The call is coded as a *message* and this is sent to the code that deals with file system management, wherever that may be located. The file system manager cannot directly copy the read data back into the memory of the client process, since both processes may be on different machines. It will reply using a message and this will be sent back to the client. Typically, the `read` routine will be waiting for the message and will return success/failure to the caller as before.

Distributed systems provide message passing as a primitive operation. They code all forms of communication between programs as messages. Considerable work has been done over the years to make message passing operate efficiently. The big problem is the amount of copying of the data that is needed. Chorus makes for a great efficiency win within one machine by using page flipping in the virtual memory to move messages. Simply, pointers to messages are used to move the data between separate processes, avoiding any data copy operations.

Message passing is a key breakthrough in kernel writing. The kernel can be split into several distinct tasks whose job is to listen for a message, take some action and return the answer in a message. Many of the transactions that were traditionally handled inside the kernel can be moved into separate servers located anywhere on the network. These servers become easy to write and understand since they fulfil the criteria for all good UNIX programs: a program doing one thing well.

Chorus

A Chorus distributed system will consist of a set of computers. Chorus calls these *sites*. A site is a closely coupled set of resources: one or more processors, memory and I/O devices. Sites are connected by a communications network, maybe a LAN or perhaps a bus.

If you look inside a site, you will see a tiny resident kernel or the 'microkernel'. This is called the *nucleus* in Chorus. It has two well-defined functions.

Distributed systems have a big problem: identifying and using resources

First, it manages local services on the site. It provides a portable real-time multi-tasking executive used to schedule and synchronise what is happening on the machine. It contains a virtual memory manager used to control local memory resources. This is mostly portable, although it does require some machine dependent hooks. It contains a machine dependent *supervisor* used to dispatch external events - interrupts, traps or exceptions.

Second, the nucleus supports a message passing system that is a global service accessible by the whole distributed system. Again, this is portable. The inter-process communication (IPC) manager is responsible for delivering messages whatever their destination within the distributed system. The IPC manager can rely on network management servers that are external to the kernel and are used to operate various protocols over the current network.

Actors

There is a set of processes running on top of the nucleus; these processes are called *actors*. An actor supports the execution of one or more *threads*. You should think of a thread as an execution path through the code. However, there can be more than one thread running in parallel through the actor. This implies that there is support for lightweight processes that will share the same address space in each actor.

An actor defines an address space that is split into a user part and system part. The system address space is shared between all the actors on the site and can only be accessed when the actor is allowed to use privileged levels of execution. Actors don't migrate. They are restricted to a particular site and their threads are executed on that site.

IPC messages flow between actors addressed to *ports*. Threads read and send messages to ports. This allows migration of services since the port (and any queued messages it is holding) can move from actor to actor. Ports have an address that is unique over the whole distributed system, this is supported by the notion of the Unique Identifier (UI). The nucleus supports a name look-up system mapping UIs onto real ports, so again we have transparency - threads can use these names without any knowledge of their actual location. It is possible to transfer UIs between actors so the knowledge of a particular service can easily be moved around the system.

Mapping UNIX onto Chorus

UNIX facilities can be split into several distinct services depending on the type of resource being managed. Chorus builds a UNIX system from a set of system servers each running in a single actor. Individual UNIX user processes are themselves actors. Notice that Chorus expects all actors to communicate amongst themselves to achieve a particular task. You should contrast this with the UNIX model where everything talks to the kernel.

Chorus supplies five system servers making up the UNIX subsystem. The *Process Manager* executes services directly related to UNIX process management: `fork` and `exec`, signals and the like. It supplies shared system code supporting a control mechanism for signal handling and providing the UNIX system call interface. When the process manager cannot execute a UNIX system call itself, it calls other servers to do the job.

The *File Manager* supplies file management services. It maintains all the bag and baggage associated with a traditional UNIX file system. A Chorus system consisting of several sites can have several file managers. Chorus provides a way to link the file system trees together to form a complete single file tree spread over the network.

NOVELL Develops in

DATAFLEX

The Benefits....

Buyers say...

"If I develop in DOS, I don't want to have to rewrite in OS/2" said Jim Baird, MIS manager for Novell Inc., in Provo, Utah. "DataFlex provides a good migratory path to OS/2 without losing what I have already developed in the DOS environment.

"With DataFlex under OS/2," he added, "I can put in one workstation and have a user do what would normally take two machines under DOS."

With more than 140 users accessing as many as 200,000 records and having to maintain a response time of less than one second, Baird likes the product's performance.

"I haven't had any problems with the corruption of data," he said. "I have users running 10 different OS/2 windows who can be working in a spreadsheet and come back to find the reports."

Baird likes DataFlex OS/2 as a development environment because of its macro capability for quick and simple programs and its solid programming language for more experienced users.

"You could start writing in lower-level code if you wanted to develop a quick program, and you could have a prototype out in 10 or 15 minutes," he said.

P.C. WEEK (U.S.A.)
February 19th, 1990

DataFlex provides quick applications prototyping and development through its relational database features and solid 4GL programming language. Once developed, this application can be easily run on DOS Networks and OS/2, as well as AIX, Xenix, Unix andVAX/VMS. Thus protecting the user's investment.

Novell are not alone in their use of DataFlex for applications development. Central and Local Government departments, corporates and software developers are just some of those who have been choosing DataFlex since 1981 - creating a library of thousands of successful DataFlex applications.

DataFlex is a powerful applications environment geared to on-line transaction processing and providing rapid access to data for large numbers of users. DataFlex not only protects your application development through technology portability, but also through technology developments, with the new options of a Database Engine, distributed database, Object Oriented Programming, CUA interface and relational report writer.

Try it out for yourselves with our special introductory offer of an evaluation copy with full documentation at £99 (including VAT and carriage). Send back the coupon below or phone our sales desk on **071-729 4460**.

The performance database for applications development

Further information from your **DataFlex** *dealer or:*

DataFlex (Information Management) Services Limited
DataNet House, 114/116 Curtain Road,
London EC2A 3AH
Telephone: 071-729 4460
Telex: 94018587
Fax: 071-739 1247

All Trademarks acknowledged

CIRCLE NO. 416

Please send me information about **DataFlex.** EV
Name _____
Company _____
Position in Company _____
Address _____
_____
_____ Post Code _____
Phone _____ Date _____
What applications areas interest you? _____
_____
DataFlex (Information Management) Services
114/116 Curtain Road London EC2A 3AH .EXE 2511

Device Managers operate asynchronous lines, bitmapped displays, pseudo-ttys and the like. They also support UNIX line disciplines. Several device managers can run simultaneously on a site servicing different peripheral devices.

The *Pipe Manager* supports UNIX pipes, providing management and synchronisation. Requests for named pipes (FIFOs) are received by the file manager and forwarded to the pipe manager. Pipe managers may be active on every site, reducing network traffic when pipes are invoked from disk-less workstations. Finally, the *Socket Manager* provides 4.3BSD socket services giving access to TCP/IP protocols.

System servers run in either user or system space. Those needing to connect some of their routines to UNIX system calls will run in system space, as will those needing to execute privileged instructions, like I/O operations.

A configurable UNIX

Chorus, then, provides a modular design allowing static and dynamic configuration of distributed systems. Once you have created a structure where servers provide resources to other processes, it is possible to take advantage of the modularity of the system in several ways. You can drop unneeded servers to generate special purpose systems, or you can replicate servers to provide fault tolerance. On a stand-alone machine, you don't need the network protocols so you can lose the network manager. On a diskless workstation, you don't need a file manager. The process manager converts UNIX file system calls into IPC requests, allowing transparent access to the file managers running on other sites.

Chorus provides easy support for multicomputers. When Chorus runs on a multicomputer like a hypercube, it can treat the hardware in a similar way to a network of servers and workstations. It is possible to make each node look like a full UNIX system to application programs, while placing the various servers at strategic points in the architecture. File servers, device managers and the socket manager will be loaded on the nodes where the appropriate peripherals are attached.

Chorus is a glimpse of the future. Maybe, over the next decade, all operating systems will be structured this way. Chorus is interesting because it is written in C++, is well developed, and has been evolving for 10 years. It is well-engineered in the sense that ingenious solutions have been found to many of the problems associated with message passing, handing interrupts efficiently and minimising context switches. Look out for it.

EXE

Peter Collinson is a freelance consultant specialising in UNIX. He can be reached as `pc@hillside.co.uk` *electronically (although your mailer might be happier to put the address the other way round) or by phone on 0227 761824.*

More reading - there are no books on Chorus as yet. The best reference material is a technical paper published in Computing Systems, the Journal of the USENIX Association, Volume 1, No. 4, 1988.

F77L-EM/32

Port 4GB mainframe applications to 80386s with this 32-bit DOS-Extender compiler. The winner of PC Magazines's 1988 Technical Excellence Award just got better. New Version 3.0 and OS include: Editor, Make Utility, Virtual Memory Support, DESQview Support, New Documentation and Free Unlimited Runtime Licenses. F77L-EM/32 and OS/386. POA.

F77L

The compiler of choice among reviewers and professionals. Includes a Debugger, Editor, Profiler, Linker, Make Utility, Weitek and 386 Real-Mode Support, Graphics. POA.

Lahey Personal Fortran 77

New Version 3.0: Full ANSI 77, Debugger, Editor, Linker, Library Manager, Microsoft and Borland C interfaces, 400 page Manual. POA.

System Science

3-5 Cynthia Street,
London N1 9JF
Tel: (071) 833 1022
Fax: 081 837 6411

CIRCLE NO. 418

DON'T GIVE IT AWAY!

**Software Developers!
Protect Your Software Against
Unlicensed Use.**

From **Link Computer** Denmark, a remarkable piece of pure software that will lock a DOS .com or .exe file to a diskette, machine or network so that you may copy (or back-up) to your heart's delight, but you can still only run the program on the designated medium.

It's called **Cop's Copylock II** and it's clever stuff. You get an unlimited number of protections per purchase and its also uncrackable. Forget your favourite copying programs - they won't work on this. Forget Option Board and Bit Copiers - we dealt with them years ago.

If you don't want to dabble with dongles and aren't so keen on your software being freeware, you ought to take a look at this.

**Ring Dino Cano on
Tel: 0763 263 073 Fax: 0763 262 620**

Link Computer ApS.

CIRCLE NO. 417

hitex
systementwicklung

The 8086/186/286 Emulator

- PC development environment
- Loads Microsoft C and MASM plus Intel PL/M, PASCAL, ASM, C
- Up to 1 MB RAM allows debugging of big systems
- Fast high-level language debugging using Intel OMF or Microsoft Code-View formats
- Debugs actual C statements - not just lines
- Up to 16 MHz emulation of the 80C186 in enhanced and compatibility modes
- Supports the 80286 in real and protected modes
- Also configurable for NEC V Series
- Proven design of rugged construction
- Part of the *teletest* emulator family

The great success of our *teletest 16* emulator is attributable not only to its outstanding technical specification but also to our commitment to looking after your interests. Every *teletest 16*, of whatever age, can be upgraded to the latest design level so that existing Hitex customers can maintain the usefulness of their equipment. Regular software updates keep all users in touch with the latest developments. A free authoritative and responsive hotline is also available to answer customers' queries.

So if you are assessing 8086 family development tools then call us now for an information pack and a demonstration disk or an on-site demonstration.

teletest units are also available for the 8051 family, Z80 and 8085.

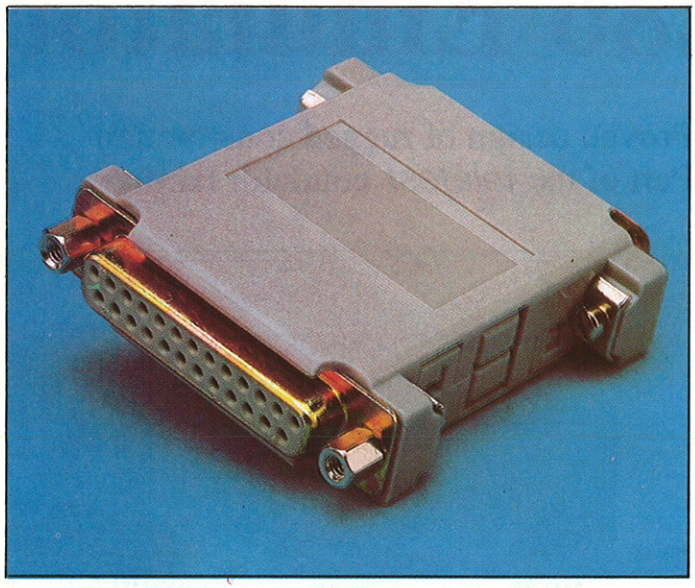
HS Systems Ltd., Warwick University, Science Park, Coventry CV4 7EZ
Tel. (0203) 692066, Fax (0203) 692131

hitex
systementwicklung

CIRCLE NO. 426

SECURITY UPDATE

SOFTLoK & SOFTLoK PLUS
software protection systems



How many users of your software actually paid for it???
Our SOFTLoK range of software protection devices are used by hundreds of software developers from small consultancies to large multinationals. They are designed and manufactured by us in the UK.

SOFTLoK
SOFTLoK units contain a code that can be read and verified by routines provided in assembler and a variety of high level languages.

Price: 10-99 units £12.00, 100+ units £8.00
Evaluation kit £20.00

SOFTLoK PLUS
SOFTLoK PLUS units contain a small area of non-volatile memory protected from unauthorised reading or writing by a password. Both the memory area and the password can be changed at any time by the routines provided in assembler and several high level languages. As the memory can even be altered in the field it can contain counters & expiry dates as well as serial numbers etc.

Price: 10-49 units £40.00, 50+ units £35.00
Evaluation kit £40.00

- ⋆ For IBM PC, PS/2 and compatibles
- ⋆ Installed in seconds in the parallel printer port
- ⋆ Assembler & high level source code provided
- ⋆ Fast response
- ⋆ Transparent to printer
- ⋆ Small physical size

SOFTLoK
INTERNATIONAL LIMITED

Units 10 & 11, Railway Road Industrial Estate, Darwen, Lancashire, BB3 3EH, England
Tel (0254) 772220 Fax (0254) 705956

SOFTLoK INTERNATIONAL LIMITED was established in 1987 with the introduction of our SOFTLoK and SOFTLoK PLUS devices to help combat the ever increasing problem of software piracy.

SOFTLoK has now broadened it's range of products to tackle unauthorised access to PC's which is an increasing threat to the business community.

SOFTLoK has a wealth of experience in the computer security market place. As well as supplying our standard products we have also designed and manufactured customised dongles for several Blue Chip companies.

If you are concerned about your computer security and would like to talk to us further, or you would like to place an order, ring us now on (0254) 772220.

. . . . As PC's become indispensable to your business, the data they contain becomes critical to it's survival. In many cases that information is your business.

DISKLoK II
PC security system

It is easy to forget that the unprotected computer sitting in your office may be insured under your contents policy but the data on that PC could well be priceless.

DISKLoK II provides complete security for your office PC and also your laptop's out in the field. DISKLoK is easy to use for the computer manager and transparent to the computer user.

- ⋆ Up to 100 users
- ⋆ Boot limit protection
- ⋆ Virus detection
- ⋆ Auto screen blanking
- ⋆ Directory/File encryption
- ⋆ For Standalone PC's
- ⋆ Audit trail
- ⋆ Floppy/DOS restrictions
- ⋆ Secure menu maker
- ⋆ Protects existing directories
- ⋆ Installed in minutes
- ⋆ Uses about 2k of memory

Prices per copy
1-9 £149, 10-49 £99, 50-99 £89, 100 POA

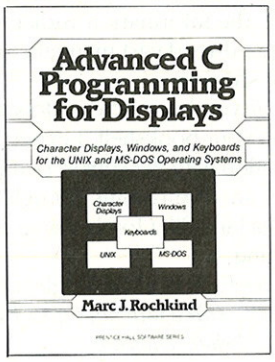
All prices excl VAT and delivery

CIRCLE NO. 419

Books

This month's selection of reading matter consists of a strongly conventional book on C and, as a Christmas treat, a novel.

A Fine Character



Advanced C Programming for Displays is perhaps a slightly misleading title, as it suggests (to me) elaborate graphics: fractals, better line-drawing algorithms, rendering etc. This book covers only character-based displays; specifically managing the MS-DOS/PC display and driving UNIX terminals. You wouldn't think there was very much meat here. After all, once you know how to clear the screen and position the cursor, there is nothing much more to a text display, is there?

The book is based around the development of a sort of 'virtual console' library. The first chapter contains a general overview of user I/O, dealing with such concepts as character-based versus graphics displays, windows and [Microsoft] Windows and so on. The author explains why, despite the success of the Apple Macintosh and other GUIs, character-based programs are still important.

Chapter 2 defines a minimal character set and introduces a few generic constants for box-line drawing. A structure to hold the coordinates of a rectangle is introduced, plus a few macros to manipulate it (these are used as the basis for operations on windows throughout the book). A number of routines are supplied to overcome tiresome system/compiler dependencies. As the book is a few years old (published 1987), and the author is trying to be portable between UNIX and MS-DOS, the code is all written K&R style. The environments explicitly supported (by `#define` constants) are Lattice C/MS-DOS, Microsoft C/MS-DOS, UNIX System III, XENIX and Berkeley BSD.

The third chapter defines the low-level routines which write to the screen. Given the environments that he is supporting, the author is obliged to write these routines at least twice (UNIX and PC), but he actually supplies *five* versions of the code (UNIX hard-wired to the escape codes of the Zenith Z-19 terminal, UNIX via Termcap/Terminfo, UNIX via Curses, PC via BIOS calls and PC by direct writes to video memory). The MS-DOS information, although well-written, is mostly standard stuff, and a bit dated (no mention of VGA, heavy emphasis on CGA 'snow' problems). The UNIX material, especially to a born-and-bred DOSite like myself, is fascinating. As well as presenting the code, the text discusses the relative merits of using Termcap and Curses, and contains a table of experimental results (which show that, if you have a communications bottle-neck, Curses is the better option; but that Termcap is the one to go for if you are short on CPU power).

Chapter 4 provides a set of low-level calls for handling keyboards. Simple functions such as testing for keystrokes under UNIX seem impressively hairy, but the main difficulty here is coping with the differences between terminals' keyboards. Cursor arrow keys and function keys always generate different return codes on different keyboards. It is possible to use the Wordstar technique - ie to put the cursor moving functions onto Ctrl shifted alpha keys - and this approach is described. However, as author Marc Rochkind correctly asserts, this is a sure fire way to irritate users who have splashed out on elaborate, expensive terminals with a full compliment of special keys. The solution is to define a virtual keyboard and allow the user to customise your program to support his hardware. Given that keyboards sometimes generate multiple keystrokes on a single key, this is a stiffer problem than you might have bargained for in the keyboard handler. Rochkind solves it with an elegant finite state machine.

Chapter 5 consists of the implementation of an application which uses the library code presented so far. The application is a simple screen editor (but not that simple: it handles multiple buffers). Of course, this editor is portable between MS-DOS and UNIX which, as the author states, makes it something of a freak.

Chapter 6 introduces the concept of windows. Again no fudges: these windows can overlap each other arbitrarily. The library routines must be passed the address of a function to call when a given window needs redrawing - shades of an OOP style system here. To demonstrate the functionality of the window functions, the editor is reworked to use them. Chapter 7, the last chapter, has the same structure as its predecessor, except that it is virtual screens that are introduced (the windows become clipped 'views' of larger screens). The editor is adapted once more to give it the ability to scroll buffers sideways within their windows.

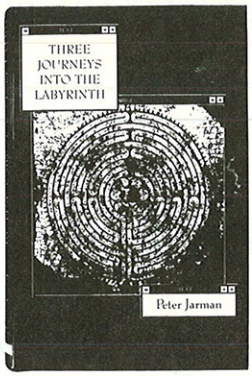
The code in this book is consistently tight and commercial standard. All the functions attempted here are easy to kludge, but hard to do well. It is the sort of library you would write for yourself, if only you had the time. If you do not wish to type all the code in (and there's a lot), you can write off for a copy on disk - but no price is quoted for this service. The other tiny cloud on an otherwise unblemished horizon is the age of the material. We received our review copy around the beginning of October; but it was first published in 1987, so some of the information is out of date. But all in all it is a good effort, and it carries my strong recommendation.

Title: Advanced C Programming for Displays *Price: £31.80*
Author: Marc J Rochkind *Publisher: Prentice Hall*
ISBN: 0-13-010240-70 *Pages: 331*

Books Received This Month

CASE on Trial, Ed. Kathy Spurr, Paul Layzell.	John Wiley	£19.95	ISBN: 0-471 92893-3	pp241
Efficient FORTRAN Programming, by Anton Kryger.	John Wiley	£28.30	ISBN: 0-471 52894-3	pp184
Running UNIX: an Introduction to SCO UNIX and XENIX, by Joanne Woodcock, et al.	Microsoft Press	£22.95	ISBN: 1-55615-270-1	pp400
Multiview: An Exploration in Information Systems Development, by D.E. Avison and A.T. Wood-Harper.	Blackwell	£14.95	ISBN: 0-632-03026-7	pp280
UNIX Shell Programming, by Lowell Jay Arthur.	John Wiley	£21.95	ISBN: 0-471-51821-2	pp271
Windows 3 Companion, by the Cobb Group.	Microsoft Press	£25.95	ISBN: 0-936767-19-7	pp520

Novel Idea



This column has, in the past, noted that there are some books that are not about computers at all. Many of them do not include code, and some of them aren't even true. We've tried to ignore these sideline novelties. This month, however, Digithurst Ltd sent us a hardback copy of *Three Journeys Into The Labyrinth*, a book written by their MD, Peter Jarman. Much of the book is about people rather than computers, although there are references to Transputers in the first chapter and the popular Autoroute package on page 162. None of it, as far as we can work out, is true. Certainly none of the names checked out.

The book documents the activities of Paul Zobel, who manages to rise above a shady career in Cold War East Germany to run a large electronics company, based in Hertfordshire. Zobel is fascinated by the fringes of artificial intelligence and multimedia. He sets his company to work on a system which will process information in the same way as the human mind (based, as far as I can ascertain, on a 486 system: possibly OS/2). But his past, as they say in the blurbs, is beginning to catch up with him. And as the net draws tighter, his work on the new system begins to mirror the paranoia and conspiracy of his Berlin days (definitely OS/2).

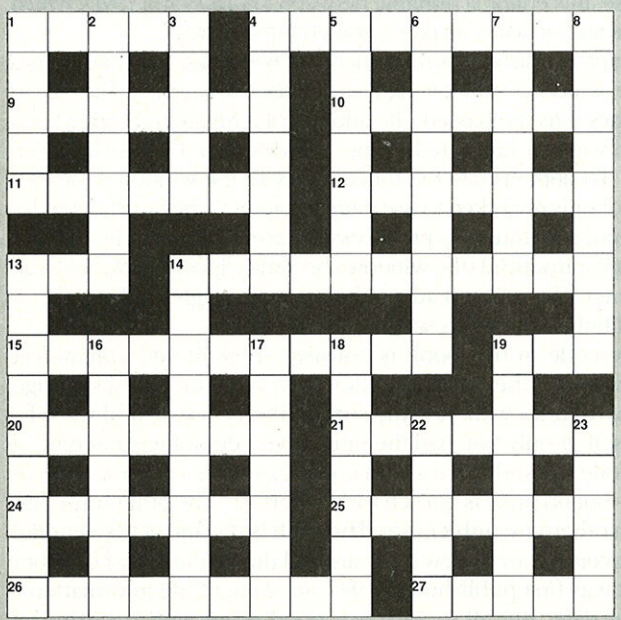
The book is printed under Digithurst's name, which makes one suspect a touch of vanity in the publishing. Jarman has written a perfectly readable novel, applying his own experiences to an intelligent and intriguing plot. *Three Journeys* starts out as a spy thriller, but it can't help toying with Big Ideas. Jarman has obviously been heavily influenced by Umberto Eco, author of *Foucault's Pendulum* and *The Name of The Rose*. The book is peppered with the same sort of fanciful, but appealingly logical notions that Italy's premier bearded semiologist loves to generate. For instance: could the Second World War and the terrorism of the 60's be explained by in-built genetic tendencies to cleanse societies of old stagnating orders? Conspiracy theories are also given a good going over, as are various bits and bobs of information theory and Platonic philosophy. It's the stuff which always seems to appeal to a certain sort of computerist: the information addict, who loves to pore over long listings, speed-read vast manuals, and who downloads every text file he or she can.

If you have Eco or Hofstadter or Dirk Gently or Computer Lib on your bookshelf, I expect you'll catch onto Jarman's own fascination with the subject of this book. For the rest of us, it still works as an entertaining, though faintly bemusing, spy tale. A handy stocking filler for the programmer who thinks he can know everything.

Definitely not enough code examples, though.

Title: Three Journeys Into The Labyrinth *Author: Peter Jarman*
Publisher: Digithurst *Price: £14.95*
ISBN: 0-9516631-0-0 *Pages: 246*

.EXEWORD DECEMBER

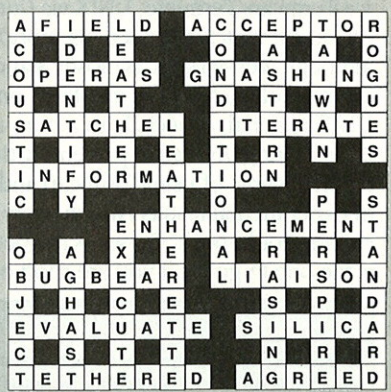


ACROSS

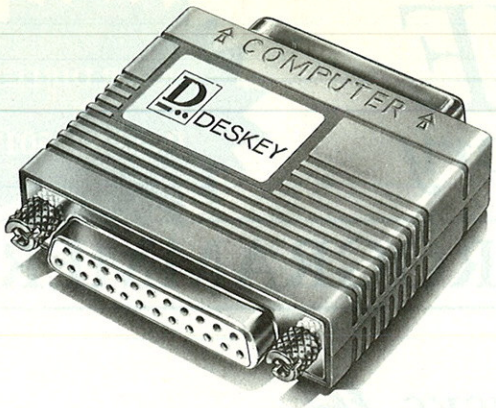
1 & 4 Our message to you now (5,9)
9 The season provides much - what a waste (7)
10 The southern one 15 in that of your own home (7)
11 Listen to the herald angels (7)
12 The start is all for mice in the rye maybe (7)
13 Seasonal colour is berry nice (3)
14 Party game winners get on top of intellects (11)
15 Tea does not, though other season's drinks do (11)
19 Home to wander round in slippers (3)
20 One who fantasises before 4? (7)
21 As the Magi go north after next festival (7)
24 Feeble reasons for sex cues in the air (7)
25 Leave round second Christmas pudding (7)
26 Go through dance or programme with timidity (4,5)
27 Monsters in the snow (5)

DOWN

1 Third 19 originally - how bitter! (5)
2 What to do to the lamp to get your wish (3,4)
3 One shout from the fox master maybe...(5)
4 ...who goes together with the hounds? (2-5)
5 How to conserve year end 9 (7)
6 Soundly add and multiply on occasion (9)
7 Tie up chicken: just a little bird (7)
8 Took off serious things, as one Diana rests a bit (9)
13 Dubious Santa's team...(9)
14 ...gets the most... (9)
16 ...from not very clear in the early syrup (7)
17 Bob like a lady of manners in brief (7)
18 The heaviest 24h of all (7)
19 Give now! (7)
22 Perhaps babyish like dear sibling (5)
23 Sounds of carols - and the outcomes? (5)



.EXEWORD NOVEMBER



DESkey

THE COMPLETE DONGLE RANGE

Data Encryption Systems Limited have more experience in the design of software protection devices (dongles) than any other company in the U.K. *12 years* experience in the design of dongles have gone into our latest 2 products: The DK1 and The DK12, both of which use the very latest in ASIC technology.

- 128 BYTES of memory split into 2 x 64. *Half is intended for both read and write, the other half is read-only. Writing to this protected half can only be performed using your unique password. This feature can be used for tasks such as identifying the modules of a multi-module package which have been paid for.*
- Down Counter. *This enables a customer to be sold 'n' goes of the software. After which the DK1 stops working until the counter is reset using your password.*
- Pseudo Random Number Generator. *Billions and billions of bits without repeating! Software and Data Encryption could not be easier. 'Seedable' too.*
- Completely Transparent to Printers, End Users and anything else requiring the port. *16 or more on any one parallel port.*
- No Hidden Extras. *Everything you need is in the DK1. No need for extra 'programming' units.*
- DESlock Software *uses DK1 or DK12 to provide instant encryption of .EXE or .COM software without the need for access to source (or .OBJ). Will even protect DOS commands. Keeps you/your employees the right side of the copyright laws.*
- Designed and manufactured by the U.K.'s leading software security specialists *Data Encryption Systems Limited.*
- DK12 *is a reduced feature DK1, available at a quantity price to beat ALL the competition (ask for a quote).*
- Serial and Bus versions available.

For further information, contact us at,

Data Encryption Systems Ltd

Edbrook House, Cannington, Bridgwater, Somerset. TA5 2QE
Telephone (0278) 653456 Fax (0278) 653300

CIRCLE NO. 421

G.W. Computers Inc.
ADCI, 4 Eagle Square,
E.Boston. MA02128
U.S.A.
Tel: 617-569-5990
Fax: 617-567-2981

System-IX (Networks) Ltd.
55, Bedford Court Mansions,
Bedford Avenue, London.
WC1B 3AD U.K.
Tel: 071-636-8210
Fax: 071-255-1038

Menu-IX | System-IX | DBMS-IX | Sysix | AI | Spell | Merge | Lock | CURU | Crypt | Tawk | Tarp

LINX fast Hardware Systems
Standard configuration for 386 systems is
2-drive, 4 mb ram, SVGA Screen and 101 Keyboard
Entry 286 systems 1 MB ram/1 Drive/chassis/Keyboard ***£495.00 !!!***

Cut | Move | Form Ctl | Where | Sort | Grep | Idle | CB Trees | Evaluate | Awk | Banner | C Source | Epoch | Help | Head | Tail

Xenix | Xenix Net | Unix | Interactive | System V | TCP/IP | DOS | Token Ring | OS/2 | Ethernet | Novell Lan | Mic Net | Aix | VPAN | VMS | QMS

LINX SYSTEMS

FEATURES
+ AMI Bios 16/20/25/33 mhz Motherboards
+ Math co-processor socket
*+ 4MB RAM on 386 **
*+ 2 MB RAM on 286 **
+ Upgradeable to 8/16 mb *
+ 5-1/4 inch drive
+ 3-1/2 inch drive
+ Dual hard disk/floppy card
+ 101 Key Keyboard
+ 150-230 watt pwr supply *
+ 0 /1 wait state *
+ LED pwr/turbo indicators
+ Real time clock
+ On board battery backup
+ 6/8/10 Expansion slots *
+ 4/6/8 hard disk bays *
+ Built in diagnostics /setup
+ Mini tower/desktop/tower
*+ 2 ser / 1 par / 1 game port **
+ Shadow ram/cache *

We sell Most major Unix & DOS Operating systems. Also Many 'C' tools and application software.

286/12 - 286/16 - 386/16 - 386/20 - 386/25 - 386/33 - 486/25

£595 - £675 - £995 - £1195 - £1345 - £1595 - £2945

Mono Screen/card
add £150

VGA Screen/card
1024 * 768
add £395

LINX SYSTEMS

Hard-Disks
20 mb mfm £199.00
40 mb mfm £345.00
80 mb mfm £595.00
100 mb sccsi £695.00
120 mb esdi £795.00
170 mb esdi £995.00
300 mb esdi £1595.00
600 mb esdi £2295.00
Tape units
CMS 80 mb £695.00
Irwin 40 mb £495.00
Irwin 80 mb £695.00
Multiports
Comtrol 4port £495.00
Comtrol 8port £695.00
Ethernet cards
WD8000 /e £155.00
WD8000/s £295.00
3COM £495.00
Excelan £695.00

UNIX - LOADED SYSTEMS
from £195.00 extra (Coherent)
All systems may be delivered pre-loaded with the UNIX system of your choice, ready to go on delivery with tape drive backups,multiport adapters and terminals. CALL for unbeatable prices.

***** Brand NEW *****
Portable hard disk technology. FITS IN A 5.25" DRIVE BAY. FRAME & REMOVEABLE DRAWER, enables you to fit a 3.5" drive of 40-200 mbyte into the draw, and remove it in 1 second for safeguard or even better , to just plug in any O/S of your choice, or take your file-systems from machine to machine. JUST £55

Compaq | Toshiba | IBM | Epson | Qume | NEC | Seagate | Wyse | Relysis | Zenith | Prism | Ranger

CIRCLE NO. 422

A SELECTION OF PRODUCTS FROM THE .EXE DIRECTORY CALL NOW FOR A COMPLETE CATALOGUE

.EXE directory

ORDER DIRECT ON 0442 824501

PRODUCTS FOR PROGRAMMERS

FREE CAR-STICKER WITH EVERY 2 OR MORE DISKS ORDERED

.EXE DISKS

A collection of specially selected utilities, for developers at all levels. These disks will actually save you hours of debugging and compilation time. Each disk contains around 1.4MB of compressed data, containing many utilities and source listings from .EXE Magazine, as well as Public Domain and Shareware utilities.

Volumes 1-7 are available at £8.00 each, in 5.25" and 3.5" formats.
For complete listings of the contents of each disk, please refer to the .EXE directory enclosed with this issue.

.EXE LIBRARY

Even the best programmer needs a good set of reference books by his side.
We have selected some of the best books covering various languages and aspects of development.

The Intensive C Course - This very popular publication illustrates the principles of good programming style and sound design. C really can be easy to learn an fun to use! *£5.95*

Inside OS/2 - Written by the author of OS/2 this book is far more than a programmer's introduction! *£20.95*

The Waite Group's MASTER C Book - 'Let the PC teach you C'. A high-powered package comprising four disks and a comprehensive book which will automatically guide you through C topics as you learn with hands-on tuition. *£39.95*

C++ for C Programmers - Take your existing C programs and turn them into C++ code. Detailed explanations on how to improve and develop code are given. *£24.25*

Liskin's dBASE IV Programming Book - So you thought you knew everything about programming in dBASE IV? This extremely practical publication gives plenty of applications to demonstrate the elements of the language, from programming fundamentals to applications design. *£28.95*

The C++ Programming Language - Written by Bjarne Stroustrup, the father of C++. Who better to provide a complete complete description of C++, with many examples and program fragments! *£23.95*

UNIX SystemV Bible - You'll never have to open a UNIX manual again. This highly recommended reference to UNIX commands and utilities, focusing on the basic and advanced command groups.. *£24.50*

FESTIVE FOLLY

You read .EXE - You're in with the in-crowd..!

Why not treat yourself or a colleague to one of these outrageous T-shirts. Be the envy of your office/squash club/pub in 1992! Full details appear in our .EXE directory. ..... *Size L £9.00 - XL £9.50*

Or be slightly more discreet and cool about being 'in' - purchase one of our .EXE mugs to let them know what a card you are! White mug, with a green .EXE logo. Big enough to drink your Christmas tipple from..... *£4.50*

More details on all our special programmer's products on offer can be found in the .EXE directory.

VISA

To place your order, call immedialtely on:

✆ 0442 824501 / 0442 890834

SAME DAY ORDER PROCESSING

Access

We will endeavour to despatchall orders taken before the 15th December before Christmas, but cannot guarantee delivery before Christmas. All products are subject to availability.

Specialist Technology Recruitment

CONSULTANCY AND PROGRAMMING FOR THE '90'S.

4GL - SUPPORT/TRAINING - HERTFORDSHIRE
TO £22,000 PA + BENEFITS

This Systems House is currently seeking a 4GL Support/Trainer. The candidate should possess at least two years experience as a 4GL analyst/programmer and should also possess classroom training expertise. This position is an unusual support role as it entails post-call systems analysis as opposed to the standard "Helpline" functions.

SENIOR CONSULTANT - HERTFORDSHIRE
TO £25,000 PA

This International Group now seeks a senior consultant possessing a minimum of 2 years PICK experience, together with a knowledge of Accountancy. UNIX expertise would be a distinct advantage. This innovative product is currently at the launch stage and therefore the successful candidate can expect genuine career progression.

INFORMIX ANALYST/PROGRAMMERS
TO £22,000 PA + CAR

Sought by a systems house looking to augment its development team. Candidates will be aged between 25 - 35 yrs., of Graduate calibre and will possess at least 2 years Informix programming experience.

AN ADABAS NATURAL ANALYST/PROGRAMMER WEST LONDON
£20,000 PA - £23,000 PA + BENEFITS

Sought by a well known software house. The requirement is for an analyst/programmer possessing 18 months + experience gained within an IBM environment.

C/UNIX PROGRAMMERS - HERTFORDSHIRE
£21,000 - £24,000 PA

This expanding software development company is seeking several Graduate 'C' Programmers possessing a minimum of 2 years experience. Informix/SQL expertise would be an asset.

MANAGEMENT CONSULTANCY - LONDON
TO £32,000 PA + BENEFITS

This prestigious "Top Ten" firm of Management Consultants now seeks a Graduate with good consulting experience possessing a range of technical expertise covering the use of Structural Analysis/Design, CASE tools and UNIX. Use of a methodology, preferably Information Engineering, is essential. It is highly likely that the successful candidate will come from a systems analysis technical consultancy or project leadership environment.

GRADUATE RESEARCHER - LONDON
£25,000 + BENEFITS

Sought by a leading firm of consultants to provide high level computing information to their senior consultants. The requirement here is for a candidate possessing analytical and computing skills in addition to experience of report writing and the production of presentations.

C/UNIX ANALYST/PROGRAMMER - SURREY
TO £21,000 PA + COMPANY CAR.

Planned expansion has resulted in this position requiring a 'C'/UNIX Programmer of graduate calibre possessing at least 18 months experience. This position may lead to a more senior appointment.

For further information on these positions please telephone 071 839 2319 (9am-7pm)or 071 266 2848 out of office hours (until 10pm)

Specialist Technology Recruitment
94 Jermyn Street, London SW1Y 6JL
Fax No: 071-930 5977

New Year New Career!

If any of these opportunities catch your imagination but don't quite match up to your requirements, then give us a call. We have a number of equally exciting and diverse options available now, whether your skills are in:-

UNIX * RDB's * Commercial * Technical * Support * Data Processing * C * C++.

*Contact Julie Poole or Mike Jenkins now on **0442 231691** days or 0442 69740 eves or weekends. Alternatively send your CV to Executive Recruitment Services, Hempstead House, Selden Hill, Hemel Hempstead, Herts. HP2 4LT or fax details to 0442 230063.*

Software Vacancies

UNIX SPECIALIST
London **to £30K + prestigious car**

We're not just looking for Software Engineers, Programmers, we are looking for well qualified professional unix developers. Your background is likely to be 3-4 years development experience on unix with a leading OEM. Your knowledge should extend beyond the operating system level, to internals and include standard development tools. In return for your urgently needed skills you are offered the opportunity to work with like-minded individuals dedicated to developing unique solutions under tight timescales for prestigious clients. The diversity of projects offered together with excellent development facilities and some of the best salaries around ensure total career fulfilment.

WINDOWS/OS2 PRESENTATION MANAGER
London/Thames Valley **£18-28K**

A joint venture company comprising two major international companies is currently recruiting for experienced software designers. In order to be part of this exciting development you will need to be degree qualified, have 2 years experience in structured software design and ideally be versed in graphic user interface design. C, UNIX, X-WINDOWS, PRESENTATION MANAGER and relational database experience is especially useful. Your chance to work on an interesting, totally unique project with some unusual benefits and an exceptional salary package.

SYSTEMS DESIGNERS
N. Herts **package to £25K + benefits + relocation**

Senior Systems Designers are required by our client, the research arm of a multi-national group which is committed to defining and developing innovative systems for software, electronics and data networks. You will be expected to provide advanced solutions based around:- * C * C++ * Graphics * RDB's * WINDOWS * UNIX * OSI and to respond quickly to a changing market. In return for your commitment, excellent salaries are offered combined with advanced skills training, efficient and flexible management and an effective career path.

THE NEXT STEP

"C" "UNIX" "OS/2"

LONDON + HOME COUNTIES

£16,000 - £25,000

I.T. Connections have been retained by a number of clients in London and the Home Counties to recruit commercially experienced IT professionals in the following categories.

Programmers,
Analyst Programmers,
Senior Analyst Programmers.

You will have a minimum of 18 months commercial experience programming in 'C'. You will also have a high degree of business acumen and good interpersonal skills.

In return you will be given the opportunity to apply for positions in the following industry sectors; Banking, Insurance, Building Societies, Travel, Construction, Software Consultancies and Management Consultancy.

For more information and a discussion on your career to date please phone I.T. Connections on 071 753 0160 or alternatively, send your cv to the address opposite. Quoting ref: C/GEN.

I.T. Connections

I.T.CONNECTIONS
160 NEW BOND STREET
LONDON W1Y 0HR
TELEPHONE: 071-753 0160
(8.00am - 6.30pm)
FAX: 071-753 0162
EVE/WE 081-577 5441

CAD CAM CONCEPTS

Despite the recession, well-qualified technical and commercial professionals are still in demand, especially with experience in one or more of the following areas:

SOFTWARE APPLICATIONS DEVELOPMENT

GIS *or* finite element analysis *or* nc

SYSTEMS SPECIALISTS

Unix support *or* X-Windows/GUI tools development

COMMERCIAL SUPPORT ENGINEERS

product marketing *or* nc post sales support/customisation.

If you would like to know more about these or other vacancies, please send your cv to **Sheila Fenlon or Michael von Rimscha, CAD CAM CONCEPTS (Recruiting), Campbell House, Campbell St, Cambridge CB1 3NE or telephone us on 0223 412965**

Project Leader **to £22k + Profit Share**

A Major Software House is seeking Project Leader for a major development under UNIX. The ideal candidate will have a good background working in a UNIX environment, together with proven Project Leader skills. Experience of development using a 4GL would be beneficial. A graduate level of education is preferred. This is an opportunity to join a major software house and ensure a positive career progression.

Software Author/Designer **£16k-£20k AAE**

There aren't many opportunities to design software that will be built into high profile consumer products and used by thousands of people all over the world. This is one. Reporting to a team leader, you will need to be a first class programmer with good 'C' experience preferably in an IBM PC environment. A knowledge of 8086 Assembler would be very helpful, and experience of using DOS essential. This is an outstanding opportunity to join a major player in the handheld computer market.

'Modula-2' Programmers **to £15k + Bens**

A major insurance company is seeking programmers with Pascal and/or Modula-2 experience to assist in a major software development. A good educational grounding together with at least 1 year's commercial experience is required. Additional skills such as DTP, QA or Technical writing skills will be rewarded over the basic salary. This is an excellent opportunity to join a team of professionals in a modern environment.

Systems Engineer **£16-£18k neg**

Reporting to the Support Manager, the System Engineer will be responsible for implementing programming projects from the proposal stage through to installation as well as sorting out various customer technical problems. It is expected that you will have a knowledge of the IBM PC and use of MS-DOS and maybe programming in languages such as 'C' or 8086 assembler. This is an ideal opportunity for a technically able person who wants to be more involved with customers. Excellent career prospects with this manufacturer of pocket size microcomputers.

Analyst/Programmer **to £17.5k**

A Major city institution is seeking an Analyst/Programmer with experience in PICK based systems. The ideal applicant will have a good educational background, a good knowledge of one or more PICK based systems and at least 12 months analysis experience. Future plans include a major UNIX development with opportunities to cross train.

'C' Programmer **£18k**

A major player in the image communications field is seeking to recruit a programmer with solid 'C' and MS-Windows experience to assist in the development of a new product. The ideal candidate will be of graduate calibre with solid development experience in 'C' under windows. A background in image processing would be a distinct advantage.

For details of these and other positions contact Terry Nelson on the number below or out of office hours on 02406 5892.

RONICOM
RECRUITMENT

46-47 Pall Mall, London SW1Y 5JG
Telephone: 071-321 0245 Fax: 071-839 7629

'C' OF OPPORTUNITIES

W. COUNTRY **£17k - £25k**
Developer of interactive graphic display and database systems requires at least one of the following skills: **'C', AppleMac, SUN, 4GL's eg. Oracle, Informix, Ingres, Sybase, Btrieve, Ctree or CodeBase 4.**

BUCKS **to £26k**
Revolutionary developer of emulation technology is keen to recruit an innovative Senior Software engineer with good **UNIX/'C'** skills with knowledge of at least one of: **Novell, AppleMac, Assembler, MS-DOS, EGA or X-Windows.**

SURREY **to £23k**
Team Leader and Programmers required by small dynamic software house developing single and multi-user manufacturing systems in **'C' and Assembler under MS-DOS or OS/2.**

BERKS **to £17k**
Software Designers keenly sought for distributed communications development project if you have one or more of: **'C', Assembler or VAX/VMS.**

BUCKS **£15k - £19k**
Predominant developer of management & automation systems is seeking solid 'C' experience under **MS-DOS.** Any **Windows or Presentation Manager** experience useful - training given.

LONDON **to c£28k**
International financial dealing room systems developer is seeking enthusiastic software professionals with at least 3 years real-time experience in **UNIX/'C'** with some of: **TCP/IP, Device Drivers, SDB, DBXtool, VAX/VMS, Porting, X-Windows, DecWindows, OpenLook, Motif or SPARC** experience.

HANTS **£16k - £22k**
Software & Systems Engineers required to work on exciting Pan European digital cellular telephony developments if you possess some of the following skills: **'C', UNIX, Yourdon, VAX/VMS or Telecomms/Mobile Comms.**

OXON **£neg**
Muti-media applications and CD-ROM developments if you have good 'C' with either **MS-Windows or SUN graphics** experience.

LONDON **£18k - £35k**
Open Systems consultancy seeking high calibre graduates with at least 2 years experience covering some of the following: **RDBMS, Ingres, UNIX, 'C', Sybase, OS/2, Presentation Manager, TCP/IP, OSI or LAN's.**

CAMBS **to £30k + car**
International IT Consultancy seeking Systems Analysts, Designers and Programmers with an impressive track record in some of the following: **'C', X-Windows, UNIX, User Interfaces, SQL/RDBMS, Ingres, Oracle or Distributed Processing.**

SUSSEX **to £23k**
Major international developer of ISDN, CCITT, Intelligent Networks and Mobile Telephony is seeking software engineers with some of the following: **Pascal, 'C', Structured Design/Programming.**

BERKS **£15k - £25k**
Vacancies have arisen in Software Development, Testing and Q.A. if you have experience in some of: **PC Operating Systems, Graphics, Networking, Systems Software, Interfacing, Multi-User Applications, 'C' or Intel Assembler.**

MANY MORE INTERESTING POSITIONS THROUGHOUT THE U.K!
Contact us to find out more about these posts or the many others we have. As specialists in the industry, we can provide you with a professional and confidential service in assisting you with the right career move. Telephone or write to one of our consultants.

081-876 0102 / 081-392 1514
ACUMEN SEARCH & SELECTION INTERNATIONAL
London House 42, Upper Richmond Road West, London SW14 8DD
Fax 081-392 1518
Evenings till 9pm 081-878 8206

ACUMEN
SEARCH & SELECTION INTERNATIONAL

BRISTOL **4GL PROGRAMMERS/ANALYSTS**

My client is a well established software house based in Bristol and they require additional Programmers, Analyst/Programmers and Senior Programmers who are experienced in using 4GL programming tools, especially Powerhouse and an appreciation of the design considerations in the use of such products. In addition commercial experience gained in Health Insurance Administration and being conversant with structured techniques, such as SSADM and Automate would be major advantages.

In return my client offers excellent benefits and the opportunity for career advancement which could lead to consultancy and management.

The roles available include:

Programmers	**to £12k**
Analyst/Programmers	**to £18k**
Senior Programmer/Team Leader	**to £24k**

To find out more about these vacancies please contact Richard Harper on 0386-49856.

HB ASSOCIATES
105 High Street, Evesham, Worcs. WR11 4EB
Telephone: 0386 49856. Fax: 0386 41925

ACTIS

PEOPLE IN UNIX*

If your skills are in the frame we can help you find a position.

AIX
WINDOWS
MICROSOFT
MSDOS
SQL
LANS
CASE
SADM
UNIX*
XENIX
CISAM
CPROGRAMMER

Opportunities North of Watford
contact
Actis Recruitment
Tel: 0204 20200
17 Chorley New Road
BOLTON
BL1 4QR.

*Unix is a trademark of AT&T

ACTIS RECRUITMENT

Job market flat??.... For G.I.S. it's not!!

Geographical Information Systems or G.I.S to the cognoscenti, is the fastest growing computer technology of the 90's. Public and private sector businesses alike are benefitting from the meaningful, graphically represented information that these interactive multi-user decision support systems provide. The UK is at the forefront of G.I.S software development.

To discerning software professionals, GIS provides the ideal technology platform to develop your career. UNIX, networking, 'C', object-oriented databases and graphics all play an enabling part. Below are just THREE of the many opportunities Concurrent Appointments is handling for software professionals to move into GIS.

UNIX Systems Manager, £25,000 + Car, Thames Valley.
An influential appointment reporting to the MD of this acquisitive GIS vendor. Use your UNIX/OSI skills to advise on systems integration, software standards and future computing direction. Career prospects to group IT Manager.

'C' Applications Programmer, £20,000, Leeds, Manchester or Cambridge.
Develop and support innovative GIS solutions based on UNIX and PCs. Plenty of opportunity for travel!! Training offered in UNIX and Relational Database design for a young, enthusiastic individual.

Software Engineer, £24,000, W.Herts.
If you have a background in UNIX and networking, particularly using TCP/IP and Novell, this GIS vendor can offer a consultancy-like role as a systems integration specialist. Training offered on the world's best-selling GIS package.

Interested in finding out more about this growing market?? Call **ALAN CARNELL**, the GIS recruitment specialist at Concurrent Appointments for an informal discussion or mail him your CV in confidence.

Concurrent Appointments
Software Recruitment

27 FIELD CLOSE
HARPENDEN
HERTS
Tel: 0582 712976
Fax: 0582 764858

WEST YORKSHIRE

Programmers (particularly COBOL and 4GLs), Analyst Programmers, Software Engineers, Project Leaders, Support (pre and post sales), Trainers (MS-DOS, UNIX and Applications). Also Hardware/Software Design Engineers.

FOR YOUR NEXT CAREER MOVE AROUND WEST YORKSHIRE

Telephone Vincent Atherton on Leeds (0532) 504560 or write to:

AIREDALE RECRUITMENT

Realtex House, Micklefield Lane, Rawdon, Leeds LS19 6AX

AIREDALE RECRUITMENT

TRAINING CONSULTANTS

Berks/Surrey
£18 - £25K + Car

genesis computer group
PERMANENT & CONTRACT EMPLOYMENT

Major training company who are expanding into the international market require two additional Training Consultants. The successful candidate will have acquired two to four years experience within a training department and technically be involved with the UNIX operating systems or SQL.RDBMS (Ingres, Oracle etc)

The position will involve training two to three days per week, designing and upgrading of course notes and cross training in various technical areas (OS/2, C++ and Windows).

You will be guaranteed a motivated working environment and constantly training at the forefront of the computer market.

34 GILLINGHAM ST. LONDON SW1V 1JZ
TEL: 071-828 4200 FAX: 071-834 7338

Exciting opportunities in

REAL-TIME SOFTWARE

*** TRANSPUTERS** — **Essex to £25K**

If *you* are a Software Professional with experience in signal processing or parallel processing then this (UNPARALLELED!) OPPORTUNITY could be for you.

*** ADA** — **Berks & Middx to £25K**

We are currently recruiting high-calibre engineers experienced in ADA/VAX/VMS Structured Methods for a number of prestigious projects. Excellent opportunities, big company benefits.

*** X-WINDOWS** — **Dorset to £22K**

Our client, an international company providing ATE solutions is offering excellent prospects to Software Engineers with experience of UNIX/Windows/C

For further information about these and our many other opportunities telephone:

0727 41101

or 0727 30602 (out of hours)
Alternatively fax your C.V. on 0727 838272

JOHN PRODGER RECRUITMENT

QUESTOR
Computer Personnel

SENIOR SYSTEMS ENGINEER — **to £27k + CAR**

Home Counties based company working on protocol Test Systems using Sun platforms. Team leader Level, minimum of 4 years' UNIX & Systems design & implementation, 3 years' C programming & in-depth experience of lower level OSI comms protocols & comms integration.

TRAINING CONSULTANTS — **to £27k + Car**

Based West of London, our client seeks consultants with development experience in Windows (C/OS2 & PM) Databases (C SQL Sybase Microsoft SQL or ORACLE). LANS COMMs (LANs or PC to IBM Host) & UNIX Consultants.

APPLICATIONS SUPPORT ENGINEER — **circa 16k**

N. Bucks base; Support Development & Training on turnkey products. Minimum 18 months' software engineering experience in a PC environment, and good C, Pascal or Assembler. Exposure to comms or 4GLs an advantage.

SYSTEMS SUPPORT ENGINEER — **circa 16k**

North Bucks base; Support Development & Training on comms products. Minimum of 18 months' software engineering experience in a UNIX environment, and good C, Pascal or Assembler.

We also have many other urgent requirements within the Home Counties and London for 'C' and UNIX Programmers. To apply for the above vacancies or discuss your next career move, please call, write or fax your c.v. in confidence to:

POLLY HUNTER
QUESTOR COMPUTER PERSONNEL
REGAL HOUSE
55b BANCROFT
HITCHIN
HERTS SG5 1LL

Tel: (0462) 438373
Fax: (0462) 421272
Eve: (0462) 459338

OS/2 on 32 terminals!

TERMINAL MANAGER provides the feature that IBM and Microsoft left out of OS/2 – multi-user operation using low-cost, Industry-standard *dumb* terminals.

TERMINAL MANAGER runs alongside OS/2 to give you a multi-user terminal system while retaining full OS/2 operations on the host PC. The key features of the software are:-

- allows connection of up to 32 terminals to a single PC either locally or remotely over modem lines
- runs most OS/2 text-mode applications
- multi-tasking at the terminal by *hot-keying* between foreground/background sessions
- most OS/2 keyboard and video function calls are supported on the terminal
- Presentation Manager, Communications Manager, Database Manager and other OS/2 components run concurrently on the host PC
- terminal programs are able to use the facilities provided by Database Manager/SQL Server, Communications Manager and LAN Server/LAN Manager
- occupies only one session on the host PC with very low memory overhead
- DOS software provided for connection of DOS PCs as terminals

If you're considering a multi-user system or if you're developing OS/2 software, TERMINAL MANAGER gives you the flexibility to add additional users in the most cost-effective way.

1 user £125
4 user £245
8 user £395
16 user £595
32 user £995

Dealers and OEMs wanted

Qiiq

Qiiq Ltd
578 Kingston Road
London SW20 8DR
England
Fax: 081-542 0318
Telephone: 081-540 7130

CIRCLE NO. 430

ADVERTISERS INDEX

ADVERTISER	CIRCLE	PAGE	ADVERTISER	CIRCLE	PAGE
Artificial Intelligence	391	34	Pinna I	380	11
Bits per Second	436	48	Pinna II	401	49
Borland	382	17	Prospero	434	30
Brent Communications	408	57	QAI	375	IFC
Cache	414	65	QAII	410	59
Camel Services	413	65	QAIII	404	53
Cebra	406	57	QBSI	393	39
Clearsoft	431	25	QBSII	402	50
Comsec	428	54	QIIQ	430	80
CTL	424	74	Rainbow Technology	377	5
Dataflex	416	67	Real Time Software	409	57
DES	421	73	Roundhill	395	42
Grey Matter	376	3	Salford S/Ware Mkting	392	37
HS Systems	426	69	Softlok	419	70
IAR	405	54	Software Con Co.	396	45
Information Architects	381	12/13	Software Generation	383	18
IXI	400	48	Software Paradise	411	60/61
Jensen & Partners	399	47	Software Security	425	OBC
Lahey	418	68	Solution Systems	378	7
Link	417	68	System IX	412	62
LPA	429	54	System IX	422	73
Magnifeye	390	31	System Science	415	65
Microcosm	397	47	Telesystems	433	29
MKS	403	51	Unipalm	385	24
Nantucket	379	9	USA Software	384	23
Nu-Mega Technologies	432	26	User Friendly	435	11
OTG Systems Inc	398	47	Winsoft	423	74
Pafec	407	57	Zortech Ltd	394	40/41

STOB versus the Software Engineers

Parity Stob, Verity's smarter elder sister, works in the defence sector. She has a poor opinion of certain software engineering practices.

How to survive a code walk-through.
1) Wrong.

Submitted code:

```
#include <stdio.h>

main()
{
  printf("hello, world\n");
}
```

Minutes of Review. Attending: Parity Stob *(Programmer)*, Bill Dull *(Token Peer Group Representative)*, John Straight *(Testing)*, Ron Little *(Design/Chair)*, Cheryl *(Minutes)*.

1. Bill Dull said that Parity Stob had forgotten to do an opening comment. Ms Stob replied that she didn't think that it was necessary with so short a program. Mr Dull said, 'It may be obvious to you what it does, Parity, but it won't be so blooming clear to the poor man that's got to maintain it. I haven't been an AP/2 for 15 years without learning anything.'

The meeting actioned Ms Stob to add an opening comment.

2. Ron Little noted that the `"hello, world\n"` string was not capitalised, as it was in his design document pseudo code. Ms Stob pointed out that it was not capitalised in the master design document, from which Mr Little's document was derived. Mr Little stated that the master design document fell beyond Ms Stob's remit.

The meeting actioned Ms Stob to capitalise the `"hello, world\n"` string.

3. John Straight enquired if `printf()` returned a value. Ms Stob believed that it returned the number of bytes written to `stdout`. Bill Dull observed that it was company policy (and had been for 15 years) to collect *all* return values. Ms Stob enquired what the Dave Allen she was supposed to do with this return value once she had collected it. Ron Little reminded Ms Stob that the purpose of the meeting was to *discover* errors, not to correct them.

The meeting actioned Ms Stob to record the return value from `printf()`.

4. Ron Little asked, 'What if `printf()` fails?' Ms Stob replied...

(Minutes continue in this vein for several pages)

...actioned Ms Stob to obtain a printout on nice green and white stripey paper.

The meeting adjourned. Ms Stob has 74 actions against her, plus one oral disciplinary warning (level 1). The code is to be formally re-reviewed, when Ms Stob has actioned the actions.

2) Right.

Submitted code:

```
#include <stdio.h>
man()
{
  printf("hello, cheeky");
        }
```

Minutes of Review. Personnel as before.

1. Ron Little said, 'Talk about Freudian slips; isn't it `main()`, not `man()`, hur-hur-hur, eh Parity?' Ms Stob replied, 'Yes Ron, you're right, what was I thinking of.' John Straight said, 'You were still distracted when you typed the string!' Ms Stob couldn't think what had come over her. Bill Dull said that the } was out of alignment. Ms Stob was covered in confusion.

Ron Little said that, technically speaking, the meeting should minute actions against Ms Stob, but - hold on a sec, Cheryl love - since it was Our Parity, we'd say no more about it.

2. Bill Dull said he would go ahead and get them in at the *EEPROM and Eaglet*. A pint of Best, a monkey-juice for John and two halves of cooking lager top for the girlies, all right?

Ms Stob said that the girlies would have vodkas and tonics, thanks Ron.

3. The meeting adjourned. On the way out, Ms Stob winked at me.

EXE

Opportunities for Software Professionals

IBM / DEC SYSTEMS

★ CONSULTANT
M4 CORRIDOR **TO £25K**

Several yrs in the PC industry. Designed software to a specification, meeting quality and design company objectives. Exp in products such as graphics, networking, PC hardware or applications design desirable. *Ref 1891/05*

★ GRADUATE S/W ENGINEERS
M4 CORRIDOR **TO £15K**

Candidates just starting their career who are interested in systems software. Some previous experience with PC operating systems, systems software, hardware interfacing, multi-user application graphics, networking or hardware, familiar with 'C' and Intel processor assembly code.

Ref 1890/05

★ PROGRAMMERS TO PROJECT LEADERS
MIDDLESEX **To £30K**

Excellent opportunities exist with this major international company for ambitious individuals with experience in one or more of the following: **PL1, IMS-DB/DC, FOCUS, IBM ASSEMBLER, WINDOWS, C, APL, DB2, ORACLE** or **COBOL**. A background in **MVS** or **XENIX/UNIX** would be an added advantage to help them develop and build tomorrow's systems today.

Ref: ACH 0202/03

★ ANALYST PROGRAMMER
CITY **£15-25K**

Ambitious individuals with one or more years' experience of **COBOL, BASIC, C, DEC VAX, UNISYS** or **TANDEM** are required for the development of standard and bespoke financial systems. Familiarity with **ORACLE, INGRES, DB2** or **LSDM** would be an advantage, as would previous city experience. *Ref: ACH/1009/10*

★ ANALYST PROGRAMMERS
BERKSHIRE **£25K**

Our client has an urgent requirement for ambitious, self motivated candidates with **IBM AS400 COBOL/RPG** and **mainframe (MVS) COBOL** skills. They may also consider candidates who have gained COBOL experience in a variety of different environments such as **DEC, HP, WANG** or **HONEYWELL**. It is essential to have two years' experience and be willing to travel in the UK and Europe to secure a position with this dynamic company. *Ref: AH/2808/05*

REAL-TIME

★ CONSULTANT
SURREY **TO £17K**

5 yrs exp in S/W Engineering Ada, Yourdon & JSD + Case tools. Teal time S/W development exp on a large project. Maintain ADCIS S/W engineering to support the methods, Ada development (ADCIS project). *Ref 1882/01*

★ SOFTWARE ENGINEER
SURREY **TO £17K**

Graduate. Knowledge of & exp of programming in Ada desirable. Coding from existing design, module testing & integration. Originating & making design changes after short period.

Ref 1885/01

★ SOFTWARE DESIGNER
SURREY **TO £20K**

Previous programming exp in block structured language using VAX/VMS within a project environment. Ada desirable. Designing part of a component using Yourdon & AIDSET (Case Tool), participating in design reviews, coding in ADA test. (ADCIS project) *Ref 1884/01*

★ SOFTWARE ENGINEERS
SURREY **TO £20K**

Experience within defence industry ideas. To provide programming skills in ADA offsite for an initial period of 6 months. Ref 2010/01

★ SOFTWARE ENGINEERS
MIDDLESEX **£22,000**

Software specialists with skills in C, PASCAL, ADA, ASSEMBLERS, UNIX, VAX/VMS and structured methodologies are required by this expanding Systems House.

Ref: ACH/1308/03

★ SOFTWARE DESIGNERS
AVON, SURREY & MANCHESTER **to £25,000**

Opportunities exist for engineers with experience in ADA, CORAL 66, PASCAL, MC68000, Object Oriented Design, Database design and 4GL's. You should be degree qualified with a minimum of three years' experience in the development of real time systems.

Ref: AH/3107/00

UNIX * UNIX * UNIX

★ SYSTEMS PROGRAMMER
BERKSHIRE **TO £17K**

Create new Run Time Systems using 8086/80286/80386 assembler and provide maintenance support to all OEM customers. Additional experience of three of the following is essential:- DOS, OS/2, COBOL, C, FLEX, UNIX or VM.

Ref: 1630/05

★ SOFTWARE ENGINEER
HAMPSHIRE **To £18K**

Join an experienced team designing and developing software that will run on 386/486 PC's. Development work will be on PCs under **Microsoft Windows** and in a networked **VAX/VMS** environment. Candidates must have two years' **C** programming skills and experience of the above mentioned systems.

Ref: ACH/2908/00

★ CONSULTANT
LONDON **c £25,000**

This international company seeks exceptional Computer Science or European Language graduates/MSc postgraduates to work in the area of product development. It is essential to have a minimum of two years' development experience using C in a UNIX environment and practical experience of SCCS, Make, sdb etc. You will be required to develop test suites, make modifications and enhancements to code and produce the necessary documentation. Other aspects of the job include in-house technical support and pre and post sales support. *Ref: AH/0808/11*

SUPPORT

★ SUPPORT CONSULTANT
BERKSHIRE

Support operating systems and C Programming, Operating systems - UNIX, DOS, Xenix, AIX, Data conversions, analysis function of data integrity validation, site customer problems, exp operating systems, technical support, C. Exp of financial packages would be preferable.

Ref 1889/05

★ SUPPORT PROGRAMMER
LONDON **£15-25K**

Involved in the development & post sales support of new & existing products. Must have exp. FORTRAN (some C & Assembler adv) 2 yrs+ exp, probably graduate. Salary as above depending on exp. *Ref 1878/12*

For further information on these or related positions call
JEREMY WILLAN or SARAH HOLTHAM on
(0734) 774234 or (0604) 33195 after 7p.m. FAX: (0734) 772773
Or write in confidence to CPS at:-

63 Peach Street
Wokingham
Berkshire RG11 1XP

CPS
COMPUTEC PERSONNEL SERVICES

.EXE
Please mark 'Later' if appropriate
Notify 050 SAH for address change
~~EC DISPLAY 2 WKS~~ ~~LIBRARY, EC~~
~~FJ WINFIELD~~ ~~INF/TECH, EC~~
~~DG ROSE~~ ~~PLANT HEALTH, EC~~
~~DG MARR~~ ~~INF/TECH, EC~~
EC LIBRARY EC

Date Seen
24.12.90
25.1.91

02686872/V5*N7/EC.S/1

Death

Taxes
Software Piracy

We can save you from one of them.

Sorry. Death we can't do anything about. As for taxes, when you use our product you'll probably wind up paying more. But software piracy: there we offer some help. Our family of software protection devices (dongles) have improved unit sales for over 2,000 companies around the world. Our products can be used in the MS-DOS, OS/2 and Macintosh environments.

Build Your Own Custom Protection Environment

Use our patented "dual-locking" ASIC chip as the basic building platform. Next, add options like: on-the-fly read/write memory, write-once or multiple-write locking codes, and encryption shells. Then add your own programming creativity to build a protection environment best suited to your product.

Users attach the device to their parallel port, and programs won't run without it. Back-up copies, hard disk and LAN operation are not interfered with.

Your Intellectual Property Belongs To You

And if you don't protect it, who will? Our products offer the most equitable way to protect your interests without sacrificing the rights of your customers. Call us today for information and demonstration units.

Software Security UK Ltd.

21A The Precinct
High Street
Egham, Surrey, UK TW20 9-HE
0784 430 060 FAX 0784 430 050

Macintosh is a trade mark of Apple Computer Inc., Activator, Mactivator are trade marks of Software Security, Inc. illustration: detail from Michelangelo's Last Judgement

CIRCLE NO. 425